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# **User's Manual for Interfacing a Leading-Edge, Vortex Rollup Program with Two Linear-Panel Methods**

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USER'S MANUAL FOR INTERFACING A LEADING-EDGE, VORTEX-ROLLUP PROGRAM  
WITH TWO LINEAR-PANEL METHODS

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SUMMARY

This report is intended to provide sufficient instructions for interfacing the Mangler-Smith, leading-edge vortex-rollup program with a vortex lattice (POTFAN) method and an advanced higher order, singularity linear analysis for computing the vortex effects for simple canard-wing combinations.

INTRODUCTION

Lifting surfaces generate vortices that can strongly influence their own aerodynamic characteristics and those of nearby surfaces. Because many aircraft fighter configurations permit and even attempt to take advantage of such vortex-surface interactions, it is important to be able to predict the effects of these interactions. A technique has been developed that combines an approximate solution for the leading-edge separation and vortex rollup off highly swept lifting surfaces with two linear-panel methods to predict the vortex interactions.

This manual is intended to demonstrate how to interface this leading-edge, vortex-rollup program with a vortex-lattice (POTFAN) code and an advanced higher order linear analysis referred to as the advanced panel code (APC). A brief outline of the leading-edge separation, vortex-rollup analysis, and method of solution are also presented.

MANGLER-SMITH METHOD

The leading-edge separation and vortex-rollup analysis presented here is used to obtain a geometrical definition of the separated sheet and subsequent vortex rollup. By using this geometrical definition, we modeled the vortex sheet in the linear analyses.

The theory (refs. 1-3) assumes slender-body conical flow in the cross-flow plane, giving a two-dimensional Laplacian as the governing equation. This means that the flow field at each cross section is independent of the flow at any other station and that variations in the stream direction  $x$  are much

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smaller than those in the other directions, at least near the body. Therefore, the full potential  $\phi$  satisfies the equation

$$(1 - M_\infty^2)\phi_{xx} + \phi_{yy} + \phi_{zz} = 0 \quad (1)$$

where the first term is negligible for highly swept wings. The general solution of equation (1) is of the form

$$\phi(x,y,z) = U_x(\cos \alpha) + U_z(\sin \alpha) + \phi(x,y,z) \quad (2)$$

where  $U$  is the free-stream velocity and  $\alpha$  is the angle of attack. The perturbation potential  $\phi$  and its derivatives vanish at infinity.

Combining equations (1) and (2) shows that  $\phi$  satisfies the two dimensional Laplacian

$$\phi_{yy} + \phi_{zz} = 0 \quad (3)$$

The conical-flow assumptions also mean that  $x$  must appear as a parameter in  $\phi$ , which must therefore be expressible in the form

$$\phi(x,y,z) = x\phi_0\left(\frac{y}{x}, \frac{z}{x}\right) \quad (4)$$

The equation of the free vortex sheet in cylindrical polar coordinates (fig. 1(a)) is assumed to be of the form

$$S(x,r,\theta) \equiv r - sf(\theta) = 0 \quad (5)$$

where  $s$  is the wing semispan at some  $x$  station. So that

$$s = x \cot \Lambda$$

where  $\Lambda$  is the leading-edge sweep angle. Two boundary conditions are applied to the sheet:

1. The vortex sheet is a stream surface, so that

$$(U \cos \alpha + \phi_x)S_x + \phi_r S_r + \phi_n S_n = 0 \quad (6)$$

Assuming  $|\phi_x| \ll U$ , equation (6) in conjunction with equation (5), becomes

$$\phi_n = -\frac{rU}{x} \sin X \quad (7)$$

2. There is a zero pressure jump across the sheet, so that

$$\Delta C_p = 0 \quad (8)$$

Using Bernoulli's equation

$$C_p = \frac{-2\phi_x}{U} - \frac{1}{U^2}(\phi_y^2 + \phi_z^2) \quad (9)$$

and therefore

$$\Delta C_p = \frac{-2}{U} \Delta \phi_x - \frac{1}{U^2} \Delta(\phi_y^2 + \phi_z^2) \quad (10)$$

but

$$\Delta(\phi_y^2 + \phi_z^2) = \Delta(\phi_\sigma^2 + \phi_n^2) = 2(\phi_\sigma)_m \Delta \phi_\sigma \quad (10a)$$

where the subscript  $m$  denotes the mean tangential velocity across the sheet. Again, from equation (4)

$$\phi_x = \frac{\phi}{x} - \frac{y}{x} \phi_y - \frac{z}{x} \phi_z \quad (10b)$$

$$\Delta \phi_x = \frac{1}{x} \Delta \phi - \frac{1}{x} \Delta(y\phi_y + z\phi_z) = \frac{1}{x} \Delta \phi - r \cos X \Delta \left( \frac{\partial \phi}{\partial \sigma} \right) \quad (10c)$$

By substituting equations (10a) and (10b) in equation (1), the pressure condition reduces to

$$\Delta \phi = \Delta \phi_\sigma \left[ r \cos X - \frac{x}{U} (\phi_\sigma)_m \right] \quad (11)$$

Figure 1(b) shows the cross-flow plane  $Z = y + iz$  at some  $x$ -station. The free sheet ABC from the leading edge A terminates at C, where the spiral rollup begins. For purposes of estimating the leading-edge wake shape, all the vorticity within the spiral can be represented by an isolated vortex of strength  $2\pi\mu UaR/x$ , situated at the center D of a small circle of radius R, which joins smoothly the free sheet at C. Using equations (7) and (11), we can show that the equation of the spiral as it approaches D is given by

$$r' = \frac{a\mu}{\theta'} \quad (12)$$

where  $(r', \theta')$  are polar coordinates relative to D.

The calculations are carried out in a transformed plane  $Z^*$  with the transformation (fig. 1(c))

$$Z^{*2} = Z^2 - s^2 \quad (13)$$

in which the vortex sheet is assumed to be represented by a circular arc  $A^*B^*C^*$  of radius  $r_1$ , and length  $2r_1\theta$ , and the rollup of the fed sheet is assumed to be equivalent to a small circle of radius  $r_2$  and center  $D^*$ . The

sheets join smoothly at  $C^*$ . The transformation equation (13) enforces the requirements that the flow must be everywhere parallel to the wing surface.

It is assumed that the vorticity distribution on  $A^*B^*C^*$  is given by

$$\gamma(\zeta) = \gamma_0 + \gamma_r \cos \zeta - \gamma_i \sin \zeta \quad (-\theta \leq \zeta \leq 0) \quad (14)$$

The seven parameters ( $r_1, r_2, \theta, \mu, \gamma_0, \gamma_r, \gamma_i$ ) are determined from the following seven equations derived from the boundary conditions and mathematical compatibility requirements.

1. Because the strengths at  $A^*$  of the sheet and its image in the imaginary axis must be equal and of opposite sign, then

$$\begin{aligned} \gamma &= 0 \quad \text{at} \quad A^*(\zeta = -\theta) \\ \gamma_0 + \gamma_r \cos \theta + \gamma_i \sin \theta &= 0 \end{aligned} \quad (15)$$

2. The free sheet  $A^*B^*C^*$  must join the spiralling fed sheet smoothly at  $C^*$ , so that the strength is continuous at  $C^*$  ( $\zeta = 0$ )

$$\gamma_0 + \gamma_r \cos \theta - \gamma_i \sin \theta = \frac{2\pi U r_2}{x} \left( \frac{a_1}{a} \right)^2 \quad (16)$$

where the right side is the strength of the fed sheet at  $C^*$ ,  $a_1$  being the distance  $A^*D^*$ .

3. The singular point of the transformation equation (13) is  $A^*$ ; therefore  $A^*$  must be a stagnation point. Mathematically, this is equivalent to the condition

$$\frac{\pi \alpha}{180} - \frac{2\mu r_2 a_2}{a_1 s} - \frac{\gamma_r}{\pi U} \theta \sin \theta + \frac{\gamma_i}{\pi U} (\theta \cos \theta + \sin \theta) = 0 \quad (17)$$

where  $a_2$  is the distance from  $D^*$  to its image on the  $O^*Z^*$  axis.

4. There is a zero resultant force condition on the vortex system similar to that in reference 4. This is equivalent to the condition that the non-singular part of the induced complex velocity at  $D$  must be  $KU/s(2Z_D - Z_c)$ . This results in two equations:

5. the normal velocity condition

$$\phi_n = \frac{-rU}{x} \sin X$$

applied at  $B^*$  and

## 6. The zero pressure jump condition

$$\Delta\phi = \Delta\phi_\sigma \left[ r \cos \psi - \frac{x}{U} (\phi_\sigma)_m \right]$$

applied at  $B^*$ .

The variables  $\gamma_r$ ,  $\gamma_t$ ,  $\mu$  are eliminated from equations (15)-(17) to give four nonlinear equations for  $r_1$ ,  $r_2$ ,  $\theta$ ,  $\gamma_0$  with

$$0 < r_2 < r_1 ; \quad 0 < \theta < \pi/2 \quad (18)$$

These are solved through a least-squares minimization using the CONMIN optimization package (ref. 5).

## STREAMLINE GENERATOR MODULE

The prediction of vortex rollup and vortex surface interactions for complete aircraft configurations must be made numerically. However, numerical methods require an initial estimate for the shape of the shed vortex sheet. In certain cases (including in particular, the case of rollup from the leading edge), the initial estimate must be reasonably accurate to guarantee convergence of the numerical method in a reasonable amount of time. Furthermore, a reasonable first guess might permit some useful results to be computed by using the trajectories of the vortices as input to POTFAN or APC. The Mangler-Smith theory provides such an initial estimate for the shape of the leading edge separated sheet. To compute the flow field, the sheet is discretized so that the separated wake is essentially modeled by a concentration of line vortices, which are described using vortex quadrilaterals. The vortex description is then combined with a panel code in which the wakes are represented by doublet panels, which are either constant in strength (POTFAN) or have a quadratic variation (APC). To align the vortex trajectories with the streamlines, the corner points along the leading-edge wake are obtained by integrating the velocity field.

The streamline generator module used is capable of producing trajectories of vortices shed from the leading, trailing, and side edges of lifting surfaces. Input consists of POTFAN geometry files describing the lifting surfaces and data necessary for carrying out the least-squares minimization as described by equations (15)-(18). Output consists mainly of POTFAN wake geometry files for interfacing the corner points defining the wake trajectories with POTFAN and APC. The streamline generator aligns the leading-edge shed wakes with the streamlines by integrating the flow field

$$\frac{d\mathbf{X}}{dt} = \mathbf{V} - (\mathbf{V} \cdot \mathbf{N})\mathbf{N} \quad (19)$$

where  $\mathbf{V}$  is the resultant velocity as computed by the Mangler-Smith theory and  $\mathbf{N}$  is the normal to the vortex-sheet equation (5)

$$\underline{N} = \underline{\nabla} S = \frac{x\underline{n} - (\underline{r} \cdot \underline{n})\underline{e}_x}{\sqrt{x^2 + (\underline{r} \cdot \underline{n})^2}} \quad (20)$$

where  $\underline{e}_x$  is a unit velocity along the stream direction and  $(\underline{r}, \underline{n})$  are the two-dimensional position and normal to the trace of the sheet in the cross-flow plane.

For the free sheet the normal is along the radius of the circular arc in the  $Z^*$  plane. The corresponding components in the  $Z$  plane are given by the transformation equation (13). For the spiral-fed sheet, the equation in the cross-flow plane is given by equation (13) so that

$$f(r', \theta') \equiv r' - \frac{a\mu}{\theta'} = 0$$

$$\underline{n} = \underline{\nabla} f = \frac{z_c}{|z_c|} \left( 1 + \frac{ir}{a\mu} \right) \quad (21)$$

Equation (19) was integrated using an improved fourth order Runge-Kutta scheme.

#### POTFAN STRUCTURE AND ORGANIZATION

The basic operational structure for the POTFAN system is shown in figure 2 and consists of a batch of programs written in modular form. Each of the modules is in an independent main program by itself. The modules communicate with each other through files. The control statements required to handle the files are supplied automatically by the program through the mechanism of command-format programming, which uses words or acronyms called "Commands" to control the action taken by the program. In addition, the program handles problems of variable size using dynamic memory allocation, thus enabling it to cope with large problems using a fixed amount of memory.

The operations are initiated through the POTGEM module that creates the geometry files for the lifting surfaces. POTWAK uses the information stored on these files to create a wake file for the corner points defining the vortex trajectories. VVIM then generates the influence matrices for the lifting surfaces while INFMAN adds in the effect of the semi-independent wakes to create a flow field  $\underline{v}$ . The boundary conditions on the lifting surfaces are calculated in BCDN. PSOLVE calculates the singularity strengths by solving the system of linear equations of the form

$$\left. \begin{aligned} \underline{v} \cdot \underline{N} &= -\underline{U} \cdot \underline{N} \\ (\underline{U} + \underline{v})\underline{N} &= 0 \end{aligned} \right\} \quad (22)$$

Finally, the forces and moments are calculated in POTFOR. Further details on some of the POTFAN modules are given in references 6 and 7. To run the program requires the following job control cards:

POTGEM. create geometry file  
POTWAK. create wake file  
VVIM. calculate influence matrices  
INFMAN. add in semi-independent wakes  
BCDN. calculate boundary conditions  
PSOLVE. calculate singularity strengths  
POTFOR. calculate and print forces and moments

7/8/9

Each card must begin in column 1. Any information typed in after the period is considered a comment and may fill the entire card. The corresponding data input decks are

7/8/9 POTGEM DATA.

.  
.  
.

7/8/9 POTWAK DATA.

.  
.  
.

7/8/9 POTFOR DATA.

In column 1 7/8/9 is typed, leaving column 2 blank. The organization of the data required for each of the POTFAN modules is described in the following sections.

#### POTGEM MODULE

This module generates panel corner-point descriptions for the lifting surfaces. It involves the specification of suitable coordinate systems for characterizing the lifting surfaces together with automatic panel generation schemes. Basically, the input to POTGEM consists of "commands," which are usually followed by data. The commands direct the logic flow and the data describes curves, panel distributions, singularity types, body rotations, reference lengths, etc. The output consists of printed output and one or more geometry files. The geometry files contain the panel corner points, boundary condition points, unit normals, and sundry other data. The geometry files are used by the other POTFAN modules that require geometry or singularity data.

Some typical input commands and their general ordering are described below:

TITLE

DSEGMENTS - defines panels on each network

CARY,SR11 — geometry definition  
 SL,SU,VL,VU — network boundary definition  
 SLBC,VLBC — corner and control point distribution definition  
 GRID — prints distributions defined in 5.  
 RUSS — rotate, shift and scale factors for network.  
 PANL —  
 DSFLAG — type of shed vortex (quadrilateral, horseshoe, etc.)  
 UVW — reads in unit wake vectors  
 FINISH —  
 STORE — stores the current geometry on a disk file or tape.  
 PRINT — prints geometry file  
 STOP

A number of specific examples are given in the following sections illustrating the sample cases that have been analyzed. The specific input requiring change to run different but similar configurations is identified.

Table 1 illustrates the input deck for a flat delta wing of  $M = 1.5$  and  $\Lambda = 74^\circ$ , with a root chord 3.4874 and semispan 1.0 (fig. 3). To run a specific case, only the following cards need to be changed:

Card 7 — NBPS = number of panels in the S-direction (chordwise)  
           NBPV = number of panels in the V-direction (spanwise)

Table 1 shows that, with ray paneling, there are 16 panels in the chordwise and 8 panels in the spanwise directions. For purposes of simplicity, a uniform panel spacing is used. More general lattice arrangements are possible and the interested reader is referred to reference 6 for the corresponding input layouts.

Card 18 — VAR2SV = root chord

Card 20 — Along the leading edge VL referring to figure 3, VAR1SV specifies the limits within which  $x$  varies, while VAR2SV specifies the bounds on the  $y$  variable.

Card 38 — FLT(1) = reference area for normalizing forces and moments.  
           FLT(2,3,4) = reference lengths for normalizing moments about  $O_x$ ,  $O_y$ ,  $O_z$  (fig. 3) axes respectively.  
           FLT(5,6,7) = direction cosines of the semi-infinite straight wakes. If these wakes leave the wing plane at an angle  $\alpha/2$ , these numbers become  $\cos \alpha/2$ , 0, and  $\sin \alpha/2$ .

In the example, the wakes leave the wing parallel to its plane. Therefore, the direction cosines are equal to 1, 0, and 0.

Card 40 — Contains the geometry file identifier that may be changed at the user's discretion.

All integers are input under a 16I5 format with floating point numbers under a 8F10.1 format. In addition, all command formats must begin in column 1 (for example, cards 24-36, of table 1 and cards 37-57 of table 2).

### Canard-Wing Combinations

Tables 2 and 3 contain the corresponding input decks for the simple canard-wing combination of figure 4 and reported in reference 8. The canard and wing are assumed coplanar. The wing semispan is 25.4 cm with a mean geometrical chord of 23.31 cm and area 516.1 cm<sup>2</sup>. The following cards only need be changed in table 2 for the canard geometry definition with standard panels (figs. 4 and 5):

Card 5 - NBPS = number of panels in the S direction (spanwise).  
NBPV = Number of panels in the V direction (chordwise).

In the example there are 10 panels spanwise and 5 chordwise. Note that the S, V directions are interchanged (figs. 3 and 5).

Cards 19, 21 - the variable VAR2SV defines the range of variation of the y coordinate of the leading edge.

Cards 23, 24 - along the leading edge VL, VAR1SV = range within which the y-coordinate varies, while VAR2SV specifies the corresponding values for the x variable.

Card 26 -- along the trailing edge VU, VAR2SV = range within which x varies

Cards 34, 35 - RSHIFT(2) = y-coordinate of the old origin in the new system obtained by suppressing the fuselage.

Cards 53, 56 - the direction cosines of the semi-infinite wakes from the trailing and side edges.

In table 2, these leave at an angle of 20° to the canard plane.

Card 59 - FLT(1,2,3,4) = as defined in table 1.

FLT(10) = x coordinate of point about which moments are taken.  
The default value is 0 in table 1.

A similar setup prevails in table 3 for the wing, where the cards needing change are:

Cards 5, 19, 21, 23, 24, 26 - changes analogous to those in table 2 for the canard.

Cards 39, 40 - corresponds to cards 34 and 35 of table 2.

Card 45 - this defines the point on the wing leading edge at which separation begins. This is defined in terms of the corresponding spanwise panel on wing.

Cards 58, 61 - corresponds to cards 53, 56, of table 2.

Card 64 - corresponds to card 59 of table 2.

In table 3, separation begins from the 11th panel. This is slightly outboard of the canard. If the panel number were 10, then separation from the wing would begin at the point of intersection of the canard tip line with the wing leading edge.

Card 32 — the AVL command adjusts the corner and grid-point descriptions of the intersections of the wing leading edge with the corner- and control-point grid lines. The required nondimensional corner-point location XADJ is calculated from the formula

$$XADJ = 2 \left( \frac{\text{corrected } y \text{ coordinate of canard tip}}{\text{wing semispan}} \right) - 0.5$$

This number should lie between (-1, 1). The corner point nearest the XADJ will be made equal to XADJ.

To calculate the corrected y coordinate of canard tip, POTGEM is run on a stand-alone basis for the canard. A partial listing of the corresponding POTGEM output is shown in table 4 under the heading PANEL CORNER POINTS. The suffixes I, J denote the spanwise and chordwise variations respectively, with J = 1, corresponding to the leading edge of the canard. The y-coordinate of the last panel point (I = 11) is the required point. Its y coordinate is 13.1121951, so that

$$XADJ = 2 \left( \frac{13.1121951}{25.40 - 3.81} \right) - 0.5 = 0.214654479$$

As an added check, the corresponding y coordinates up to I = 11 for the POTGEM wing program must be identical for the wing and canard. The spanwise panels for the canard and wing were generally selected according to the rule

$$\frac{(NBPS)_c}{(NBPS)_w} = \frac{\text{canard semispan}}{\text{wing semispan}}$$

#### POTWAK Module

This module generates the corner points for the vortex trajectories by solving the equations of the Mangler-Smith theory. The leading-edge wake-corner points are generated by an improved Runge-Kutta numerical integration of the flow field equations 19. In addition, there is a graphics capability for the display of the vortex trajectories. The program expects the following data to be entered by the namelist \$DATA.

NSEGS — number of segments for discretizing each wake line from the leading edge. For highly swept wings at moderate angles of attack a value of 150 is generally found to be adequate. As the angle of attack decreases, NSEGS must be increased.

ALPHA — angle of attack in degrees. Default is 15°.

UINF — free-stream velocity. Default is 1.0 in nondimensionalized units.

ID — Identification number of the corresponding lifting surface geometry file. For the wing-alone case this number is given on card 40 of table 1.

PLOT — Logical variable whose truth causes the wake and lifting surface geometry to be plotted on the E&S picture system. Default is .FALSE.

STORE — logical variable whose truth causes the wake and lifting surface geometry information to be stored on permanent file. Default is .TRUE.

IDWAKE — identification number of the wake file. IDWAKE is not required if STORE=.FALSE.

DELTAx — x direction step used in calculating the leading edge vortex trajectories. Default of 0.1 in nondimensionalized units. DELTAx must increase in proportion to NSEGS.

R1 — estimate of radius of the circular arc in the  $Z^*$  plane representing the free sheet. Default in nondimensionalized units is 0.0765.

R2 — estimate of radius of the circle representing the fed sheet in the  $Z^*$  plane. Default is  $9.25E-3$ .

THETA — estimate of half angle subtended by the finite circular arc in the  $Z^*$  plane. Default is 1.24 rad.

GAMO — estimate of parameter associated with the vorticity distribution on the free sheet. Default in nondimensionalized units is -0.06384.

STASHN — station code for the disposal of the plot file. The initial default value is 1, which will cause the plot file to be sent to the FAE PDP-11. A value of 2 causes the file to be sent to the RJE terminal in Building 227 and a value of 3 causes it to be sent to the central-site printer. STASHN is not required if PLOT=.FALSE.

IRKN — to reduce NSEGS to manageable levels, the integration scheme uses a number of intermediate points to generate a single Runge-Kutta point. This number is represented by IRKN. For angles of attack that are sufficiently small either NSEGS must be large or IRKN must be increased. This also applies if the wing is not sufficiently swept. Suggested values are NSEGS = 150 and IRKN = 10.

VLB, VUB, IPRINT, NCON, NSIDE, INFO, ITMAX, ICNDR, NSCAL, SCAL, ITRM, CTL, CTLMIN, PHE, DELFUN, DABFUN, FDCH, FDCHM, THE, NFDG, LINOBJ, CT, CTMIN — CONMIN parameters defined in reference 5. The CONMIN parameters PHI and THETA are denoted here by PHE and THE. For the optimization technique to converge it was generally found that the finite differencing parameters FDCH and FDCHM for estimating the function derivatives must be small  $-1.E-9$ . This is because of the presence of trigonometric functions in equations (15)-(17), which could give rise to multiple solutions for the least-squares minimization. These parameters need not be changed in normal use.

IFLAG, ILINE, IYLO, IYHI, IZLO, IZHI, IARGMIN, IARGMAX — parameters used in the subroutines for the picture system as defined in reference 9. These parameters need not be changed.

A typical listing is shown in table 5 for the delta wing whose configuration is described in table 1, corresponding to an angle of attack  $\alpha = 20^\circ$ . The default values for the Mangler-Smith parameters R1, R2, THETA, and GANO are those appropriate to a  $60^\circ$  delta wing at  $15^\circ$  angle of attack. These default values were found to be adequate for all the cases run and gave very rapid convergence. For a wing with ray paneling, the number of wakes shed from the leading edge is given by

$$N\text{LINES} = N\text{BPS} + 1$$

Currently,  $N\text{SEGS} * N\text{LINES} \leq 10000$ .

The picture system displays the leading-edge vortex trajectories in the cross-flow plane, the (y,z) coordinates being scaled with respect to the stream coordinate x (fig. 6). The conical-flow assumptions imply that these trajectories must coincide for different x-stations. The straight segments represent the semi-infinite line vortices from the trailing edge. This is followed by orthogonal perspectives of the trajectories, figure 7.

Table 6 shows the organization of the wake geometry output files, consisting of a number of records arranged according to the POTFAN formats. Record 1 contains information relating to the flow-field characteristics, the number of wakes N LINES shed from the leading edge, the number of points NSEGS describing each wake, the wake file identification, and other sundry POTGEM data. Record 2 contains the wake corner-point arrays XWAKE, YWAKE, and ZWAKE. Records 3-5 contain miscellaneous information that enables POTWAK to converse smoothly with the other POTFAN modules as and when the need arises.

To run the canard-wing case it is necessary to call POTGEM twice with different identifications. For example, the canard file could have an ID = 8701, while the wing has an ID = 8702. This is then followed by two calls of POTWAK with corresponding ID's in its input. The output files from POTGEM and POTWAK can now be used to access the other POTFAN modules needed for the aerodynamic calculation.

#### VVIM Module

The VVIM module computes the influence matrices for the lifting surfaces, each element of the matrix representing the effect of a unit singularity such as horseshoe or quadrilateral vortices. VVIM is needed to form part of the set of simultaneous linear equations that represent the boundary conditions appropriate for given angles of attack. Input to VVIM consists of geometry files and user input. The user input consists of commands (which direct the logic flow) and data needed to effect the commands. The major commands in VVIM are the following: BREAD commands, which cause the geometry of sending (influencing) and/or receiving (influenced) components to be read in; IMAGE,

which causes the appropriate image matrices and offset vectors to be calculated; COMPRESSIBILITY, which causes geometries to be stretched to account for compressibility effects and which causes the velocity stretching data to be computed; SETWAKES, which can be used to change the wake shedding direction; and INF1, which causes the actual influence matrix calculation and storing.

Output from VVIM consists of printed output and influence matrix files. The influence matrix files are used by PSOLVE, which is the equation-solving module, and by POTFOR, which is used to calculate forces, pressures, etc.

Table 7 shows the VVIM input deck for the wing-alone case of tables 1 and 5. No changes are needed in this deck to run different cases. Card 4 shows that the POTGEM file is accessed through ID = 30701. Card 6 instructs VVIM to store the boundary condition information on a disk file with ID = 3201. NRWMAX is the number of lifting surface networks.

Table 8 shows the VVIM input deck for the canard-wing case of tables 2 and 3. This table is divided into four blocks; each block is similar in structure to table 7. This division corresponds to a partitioning of the influence coefficient matrix for the lifting surface into four submatrices representing the canard-wing interactions

$$\underline{A}\underline{\Gamma} = \begin{pmatrix} \underline{A}_{cc} & \underline{A}_{cw} \\ \underline{A}_{wc} & \underline{A}_{ww} \end{pmatrix} \begin{pmatrix} \underline{\Gamma}_c \\ \underline{\Gamma}_w \end{pmatrix} \quad (23)$$

The canard-wing case was run at a Mach number of 0.3 (card 15), so that the Prandtl-Glauert compressibility effects must be included in the calculations, while table 7 corresponds to a zero Mach number, so that the COMP command is not needed. The canard POTGEM file was accessed through ID = 8701, while the ID for the wing geometry file is 8702. The resulting partitions  $\underline{A}_{cc}$ ,  $\underline{A}_{cw}$ ,  $\underline{A}_{wc}$ , and  $\underline{A}_{ww}$  are stored on disk file with respective ID's = 8801, 8802, 8804, and 8803. The only card which needs to be changed is card 15 for the Mach number. To calculate the singularity strengths  $\underline{\Gamma}$ , it is necessary to augment the lifting surface, influence matrix  $\underline{A}$  to include the effects of the wake networks. This is done in the INFMAN module. The output from VVIM consists primarily of the normal components of the induced velocities due to the lifting surfaces. In INFMAN the effects of the shed wakes are added to the normal velocity components to give  $\underline{v.N}$  term in equation (22).

#### INFMAN Module

Wakes may be treated either as completely independent networks or as parts of the lifting surfaces to which they are attached. Treating wakes as independent networks is disadvantageous because unnecessary unknowns are introduced and because pressures on panels adjacent to wake attachment lines will be incorrect. Treating wakes as integral parts of the lifting surfaces to which they are attached is disadvantageous because this limits wake shapes to be in the form of singly ruled surfaces, which is unsatisfactory in the case

of leading- and side-edge rollup, or both, because it results in inaccuracies during calculations of the influence matrices.

The INFMAN module can therefore handle generally shaped wakes and yet be cognizant of the fact that wakes are attached to and dependent on their generating surfaces. INFMAN uses the wake corner points generated in POTWAK to compute the influence of these finite vortex segments through the Biot-Savart law. This is then added onto the velocity field computed in VVIM resulting from the lifting surfaces to give the resulting perturbation velocity  $\underline{v}$ .

Table 9 shows the INPUT deck for the wing-alone case of tables 1, 5, and 7. Some of the command formats used are described below:

1. VNADD — this causes the influences of one or more wakes to be added to the normal influence matrices (i.e., velocity-dot-normal) that do not include the effects of the shed wakes.

At this point, the program expects the following data to be entered by the namelist \$DATA.

NCOMP — number of lifting surface networks. Default is 1.

NIWKS — number of independent wake networks. Default is 1.

IDGEOM — array of identification numbers of the geometry files for each lifting surface.

IDWKGM — corresponding array for the wake file.

IDIN — array containing the identification numbers for the normal influence matrices for the lifting surfaces including the effects of the shed wakes.

IDOUT — array containing the identification numbers for the revised matrices including the effects of the shed wakes.

COROPT — integer defining the specific type of core model. Cores are used to alleviate unrealistically high velocities near the finite strength line vortices that are used to represent each wake.

CORPOT = 1 creates uniform core sizes.

COROPT = 2 creates core sizes that generally depend on the geometry of the wake. In particular, this option usually results in core sizes that are equal to a certain fraction of the "distance" between a segment and the closest other segment that is not on the same wake line.

PARAMC — Array containing parameters defining the core size. The only one of interest to the user is the first element PARAMC(1), giving the core radius corresponding to the COROPT option.

2. VEADD — this command causes the influence of the shed wakes to be added to the velocity influence matrices that do not include shed wakes.
3. VIADD, V2ADD — similar status to VEADD.

The VNADD command is addressed primarily towards enforcing the boundary conditions of equation (22) by forming the  $\underline{v.N}$  terms. Commands VIADD, V2ADD enable the resultant velocity field ( $\underline{v} + \underline{U}$ ) to be computed in POTFOR.

From figure 3, the length of the wing leading edge is  $\sqrt{3.4874^2 + 1} = 3.6279$ . With 16 chordwise panels and for a constant core size model COROPT = 1 the panel spacing along the leading edge is given by  $3.6279/16 = 0.2267$ . Card 5 in table 9 shows the core radius PARAMC(1) to be taken as half this value. As before, the geometry and wake files have ID = 30701. The ID for the  $\underline{v.N}$  matrix in card 4 is IDIN = 3201, thus overwriting the ID for the corresponding matrix without shed wakes, cards 6, 8, 10 of table 7. The velocity matrix  $\underline{v}$  has an identification IDOUT = 3202.

Table 10 shows the corresponding INFMAN deck for the canard-wing case of tables 2, 3, and 8. This consists of two blocks each of which has essentially the same structure as table 9 for the single-lifting-surface case. This uses the two geometry files with IDGEOM = 8701, 8702. For the canard the wake file has IDWKGM = 8701. The  $\underline{v.N}$  partitions for the canard corresponding to  $\underline{A}_{cc}$ ,  $\underline{A}_{cw}$  of equation (23) has IDIN = 8801, 8802, thus overwriting the corresponding IDIN in table 8 (cards 17, 19, 21, 31, 33, 35). The  $\underline{v}$  matrices are stored with new IDOUT = 9901, 9902. Similar remarks apply to card 19 of table 10 for the wing. The normal influence matrix of the wing is stored on a disk file with IDIN = 8804, 8803, with the velocity influence matrix having IDOUT = 9904, 9903. Cards 7 and 20 show that the canard and wing use a uniform core model.

From figure 5, the length of canard leading edge is 21.685 with 10 spanwise panels so that the spacing along the canard leading edge is 2.1685. Card 7 shows that the core radius PARAMC(1) has been taken to be half this value. Card 20 gives the corresponding value for the core radius associated with the wing. It should be remembered that separation from the wing leading edge takes place outboard of the canard.

The INFMAN module consumes the major portion of the CPU time. If the program exits on time, restart operations from INFMAN with the commands VNADD, VEADD, and VIADD replaced by VIADD, V2ADD, and STOP, respectively. The only cards needing change are card 5 of table 9 and cards 7 and 20 of table 10.

#### BCDN Module

VVIM in conjunction with INFMAN generates the normal influence matrix  $\underline{v.N}$  of equation (22). The BCDN module computes the  $\underline{U.N}$  matrix, from which the singularity strengths can be then calculated by solving the set of linear equations (22). These boundary conditions are enforced at one point of each panel of the lifting surfaces.

Input to BCDN consists of POTFAN geometry files and user input. The user input consists of commands and data needed to effect the commands. Included in this data are geometry-file identification numbers, angles of attack and sideslip, and rotation rate vectors.

Output consists of printed output and boundary-condition files. The boundary-condition files are used by PSOLVE (the equation solving program) because they form the right sides of the systems of equations that generally occur when analyzing aircraft by the panel method.

Table 11 shows the input deck for the wing-alone case. Some of the BCDN commands involved are listed below:

GREAD — reads in the required geometry information. For the wing-alone case this ID is 30701.

BCREAD — reads in boundary condition information such as ALPHA=angle of attack and NSETS=number of sets of boundary conditions to be computed.

CBCV — computes the right-hand side matrix U.N.

SBCV — stores this in a file; the corresponding ID in table 11 is 3201.

Tables 12 and 13 show the BCDN input structure for the canard-wing case. Module BCDN must be called twice, once to set up the canard boundary conditions using canard geometry file 8701 and store this information on a file with ID = 8801. This is followed by a second call of BCDN for the wing with ID = 8702, 8802. For the wing-alone case (table 11) only the angle of attack, ALPHA in card 4 needs changing. For the canard-wing case of tables 12 and 13, no changes need be made. The angles of attack appearing in cards 4 are subsequently overwritten in POTFOR.

The linear equations (22) are solved in PSOLVE for the singularity strengths.

#### PSOLVE Module

PSOLVE uses an LU decomposition method with partitioning developed by the Boeing Company. Input to PSOLVE consists of influence matrix files created by VVIM and INFMAN, right-hand side vectors created by BCDN, and user input. The user input consists of commands and data needed to effect the commands.

The output from PSOLVE consists of printed output, solution files, and inverted or partially inverted influence matrices. The solution files are used by POTFOR to calculate the forces, moments, pressures, etc.

Tables 14 and 15 display the PSOLVE input decks for the wing-alone case and the canard-wing case, respectively. These decks need not be changed during runs. The user input is entered by the namelist \$DATA and consist of:

NCOMP — number of lifting surfaces. Default is 1.  
 IDIN — influence matrix ID.  
 IDBC — boundary condition (-U,N) ID.  
 IDS — solution file ID created as a result of PSOLVE.

For the wing-alone case IDIN = 3202, corresponding to IDOUT = 3202, card 4 of table 9. Again, IDBC = 3201, corresponds to card 7 of table 11. The solution ID is now carried over to 3201, overwriting previous information.

Table 15 is essentially a generalization of table 14. Elements of the IDIN array of table 15 correspond to IDOUT in cards 6, 19 of table 10. IDBC = 8801, 8802 is transmitted by cards 7 of tables 12 and 13. The singularity strengths  $\Gamma_c$ ,  $\Gamma_w$ , corresponding to the canard and wing, respectively, are stored in files with IDS = 8803, 8804.

#### POTFOR Module

Finally, POTFOR calculates the forces, moments, pressures, etc., using the Kutta-Jonkowski equation

$$\Delta P = \rho \Gamma v \times \Delta l \quad (24)$$

Input to POTFOR consists of POTFAN velocity-influence matrix files, solution files, geometry files, and user input. The user input consists of commands and data needed to effect the commands. The seven major POTFOR commands are the following (tables 16 and 17).

1. READ — reads in geometry and singularity data for a network. The following data is expected from the \$DATA namelist.

IDG = ID of geometry file.

For table 16, this is 30701, while for the canard-wing case of table 17 IDG = 8701 for the canard file and IDG = 8702 for the wing geometry file (cards 4, 5, 31 and 32).

2. ATTITUDE — this causes attitude data to be read in. The following data is entered via \$DATA namelist.

IDSF = ID of solution file. This is the output from PSOLVE module.

For the wing-alone case IDSF = 3201, card 3 of table 14. For the canard-wing case IDSF = 8803, 8804, from card 2 of table 15.

3. COMBOS — this command determines a transformation matrix from which the "combinations" may be determined from the "cases." By definition, a case corresponds to a boundary condition vector calculated by the boundary condition program and for which a solution vector was determined by the equation-solving program. A combination is a

linear combination of cases. For example, the solutions for two different angles of attack may be combined to yield solutions for many different angles of attack.

This command must be preceded by a READ command. All groups are dropped except those containing the geometry information. Subsequent commands may thus overlay whatever force information has been computed at this point.

The COMBOS command is required after every ATTITUDE command provided that the desired combinations are different from the cases.

The program expects the following input by the \$DATA namelist:

NCOMB = number of combinations.  
ALPHA = angle of attack.

4. NETLOADS — this calculates the net forces and moments using the Kutta-Jonkowski equation (24). The following data is input from the \$DATA namelist:

NCOMP = total number of lifting surfaces. Default is 1.

IDVE = identification numbers for the boundary condition velocity influence matrices.

IDS = ID for the solution vector of the lifting surfaces that have a velocity influence on the current surface.

PRINTV = logical variable whose truth causes the net velocities at the boundary condition points to be printed. Default is .FALSE.

In table 16, IDVE corresponds to IDOUT = 3202 of the INFMAN module (table 9), while IDS corresponds to IDS = 3201 of PSOLVE (table 14). A similar generalization holds for table 17, in comparison with tables 10 and 15.

5. PRESSURES — computes pressure distributions on the lifting surfaces. This requires the following data:

POPT = 0 computes pressure in the usual way ( $\Delta P.N/\text{area}$ ), the default value.

6. SPANLOADS — calculates span loads and requires the following input in \$DATA namelist:

SOPT = integer variable whose value determines what types of spanloads will be calculated. Default is 0. This causes the spanloads to be normalized by the local chord and resolves in the wind-centered coordinates. This produces section lift and induced drag.

SOPT = 1 spanloads normalized by average chord CAVG.

CAVG = FLT(3) of POTGEM

7. NETK — similar in purpose and organization to the NETLOADS command, but can also include edge suction forces for thin lifting surfaces.

From the user standpoint however, table 16 for the wing-alone case needs no changes, while table 17 for the canard-wing case requires only one change for the angle of attack at card 9.

#### POTFOR Output

The POTFOR output for the wing-alone case is displayed in table 18. The forces, moments, and pressures are calculated from equation (24). The POTFAN program uses two versions of this formula: an approximate or modified version that uses the mean velocity over each panel. This is computationally faster and better able to model curved surfaces. The exact version uses the correct velocity  $v$  on the panel boundary and gives good agreement with experiment for the wing-alone case. The approximate version consistently gave worse results. However, for the canard-wing case, sometimes the approximate version performed better. In table 18, the first eight outputs correspond to the approximate version and the last three to the exact version.

1. VELOCITY AT CONTROL POINT LOCATIONS: This contains the velocity components  $u$ ,  $v$ , and  $w$  at each of the panel control points at which the boundary conditions 22 are enforced.  $I3 = 1$  indicates the wing has no thickness or camber.

The index  $I2$  runs from 1 to  $NBPV = 8$ , which is the number of spanwise panels and  $I1$  runs from 1 to  $NBPS = 16$ , the number of chordwise panels. The ray nearest the leading edge corresponds to  $I2 = 1$ . The  $u, v$  components on this ray are fairly uniform near the apex and trailing edge, indicating nearly conical flow. However, within the interior of the wing, the flow field is less conical. The  $w$ -components throughout are very small, as indeed they must be, because the flow must be tangential to the wing as indicated by equation (22).

2. NORMF, NORMM, ADD: These are defined by:

NORMF = normalization factor to convert dimensional forces to coefficients;

NORMM(1,2,3) = normalization factors to convert dimensional moments to nondimensional coefficients;

ADD = logical variable whose truth causes accumulation of forces and moments.

NORMF, NORMM(1,2,3) are defined by:

NORMF = 1/FLT(1);  
NORMM(1) = NORMF/FLT(2);  
NORMM(2) = NORMF/FLT(3);  
NORMM(3) = NORMF/FLT(4)

where FLT is accessed through the geometry files. Table 1 shows that FLT = (1.7437, 1.0, 3.4874, 1.0), so that NORMF = 0.573 as indicated in the output display.

3. COMBINATION: 1 lifting surface. (FX,FY,FZ) and (MOMX,MOMY,MOMZ) are the net force and moment coefficients on the network. (FXW,FYW,FZW) are the force coefficients in the wing centered coordinate system with FXW = drag, FYW = side force and FZW = lift. (MOMXW,MOMYW,MOMZW) are corresponding the moments coefficients with MOMXW = rolling moment, MOMYW = pitching moment, and MOMZW = yaw moment.
4. COMPUTATION OF PRESSURES: The default value of SOPT in the PRESSURE command is POPT = 0. In figure 3, S,V corresponds to the x,y coordinates. Table 18 then shows the spanwise variation of pressure coefficients.
5. SPANWISE LOAD DISTRIBUTION: Reference chord = CAVG = FLT(3) of POTGEM. Components of the force on each spanwise row of panels are FXBW, FYBW,FZBW. These forces are made nondimensional by the product of the dynamic pressure and CAVG. These are expressed in the wind centered coordinate system. For a wing with ray paneling the longitudinal load coefficient is given by

$$C_n = \frac{\int_{-s}^s \Delta C_p dy}{b/2} = \sqrt{(FXBW)^2 + (FZBW)^2} \quad (25)$$

where b is the wing span and s is the local semispan.

6. VELOCITY AT N1 FORCE SENSING LOCATIONS
7. NET FORCES CAUSED BY N1 VORTEX SEGMENTS
8. VELOCITY AT N2 FORCE SENSING LOCATIONS: This velocity information is not directly relevant to the user. It contains intermediate calculations for assembling the velocity contribution in the N1, N2 directions. The correct use of equation (24) requires the velocities be calculated along the panel boundaries rather than using a mean velocity at the control points. POTFAN arranges the corner points in a rectangular grid spanned by directions N1, N2 corresponding the number of corner points along the leading edge, and number of points characterizing each shed wake.

The composite effect is described in the following headings, which give the output of the second method of computing the forces and pressures.

9. NET FORCES CAUSED BY N1 AND N2 VORTEX SEGMENTS: These give the force and moment coefficients for the exact use of 24.
10. COMPUTATION OF PRESSURE
11. SPANWISE LOAD DISTRIBUTIONS

The layout of the output for the canard-wing case is virtually the same, and comes in two blocks corresponding to the canard and wing, respectively.

### The Advanced Panel Code

The user's manual for operating the pilot version of the APC is given in reference 10. The user has to prepare a subroutine INPUT written according to the specifications given in reference 10. This must contain in particular, a mechanism for calculating and accessing the wake corner points for the leading-edge vortex trajectories. This interfacing is done through POTFAN geometry and wake files.

Table 19 contains a listing of the subroutine INPUT for the wing-alone case already encountered in POTFAN. The user input is entered through name-lists DATA0, . . . , DATA4. The variables involved are defined through a series of comment cards. The program distinguishes lifting surface networks and wake networks through an integer NTD, which is 18 for a wake and 12 for a lifting surface.

There are two wake networks: a wake network from the leading edge and a semi-infinite sheet from the trailing edge. The most convenient way of generating the latter is to create a second fictitious semi-infinite rectangular wing attached to the trailing edge of the actual wing. This is done through a POTGEM file shown in table 20, which is very similar to table 1.

A rectangular wing of length 9500 units and semispan 1 is used. This arrangement has 15 panels spanwise and one chordwise panel. The ROSS command is used in cards 30, 31 to position the wake at the wing trailing edge. The POTGEM file for the actual wing is identical to that in table 1. While POTFAN was not sensitive to the direction of the final semi-infinite vortex segment from the leading edge, the APC was sensitive to this direction. It was found desirable to orient this line at an angle  $\alpha/2$  to the plane of the wing. So that FLT(5) on card 33 must be replaced by  $\cos \alpha/2, 0, \sin \alpha/2$ . It should be noted that NBPS for the trailing-edge wake, card 6 of table 20 must have the same value of NBPV for the wing, so that the grid point along a common boundary are identical.

The data for the subroutine INPUT is given in table 21; almost all of this data block are APC variables which are described in reference 10. The data organization is summarized below:

First read statement at line 71.  
 Second read statement at line 218. Read in \$DATA2 namelist.  
 Third read statement at line 221. Read in \$DATA3, within the DOLOOP1000.  
 Fourth read statement at line 257 - \$DATA1  
 Fifth read statement at line 259 - \$DATA4  
 Sixth read statement at line 362 - \$DATA0  
 Seventh read statement at line 381 - \$DATA1  
 Eighth read statement at line 383 - \$DATA4

The leading-edge wake corner points are accessed between lines 360 and 379. This is the information contained in table 6. The subroutines OPENR and RELFIL are part of the POTGEM module and are described in reference 6. The APC uses a main overlay program called FEE, which must have its argument list expanded up to tape 20 to be compatible with the POTFAN disk file system so that

```

OVERLAY (FEE,0,0)
PROGRAM FEE (INPUT, OUTPUT, TAPE1,.....
TAPE 4, TAPE 5 = INPUT, TAPE 6 = OUTPUT,
TAPE 7....., TAPE 20)
.
.
.
STOP
END
  
```

This sequence of cards is placed at the end of the subroutine INPUT. The job control cards are shown in table 22. The program organization is shown in figure 8.

A major drawback of the technique is the current upper limit of a 1000 panels for all the networks. To get realistic results for the wing-alone case requires about 990 panels. It is felt that currently comparable results are not possible for the canard-wing case with this restriction.

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TABLE 1.- POTFAN GEOMETRY INPUT (DELTA WING, RAY PANELS)

POTFAN GEOMETRY PROGRAM. VERSION 1.3

\*\*\*\*\*

TIME = 04/20/78 12.22.52

ENTER BATCH

```

*****
*                               I N P U T                               *
*****
1 *TITLE
2 *CANARD WAKE HOLL UP PROGRAM
3 *CANY
4 *SH11
5 * SINCVR1 IC=1,COPT=0 SEND
6 *USEGMENTS
7 * $DATA NBP5=16,NHPV=8 SEND
8 *VLBC
9 * $DATA SEND
10 *SLHC
11 * $DATA IUPTE=0 SEND
12 *GRID
13 *SL
14 * $DATA IUPTSV=0 SEND
15 *VU
16 * $DATA SEND
17 *VE
18 * $DATA IUPTSV=1,NTAHSV=1,VAR2SV=3.4H74 SEND
19 *VE
20 * $DATA NTAHSV=2,VAR1SV=0,,3.4H74 ,VAR2SV=0,,1.0 SEND
21 *PANEL
22 * $DATA RS1=T,RS2=T SEND
23 *DSFLAG
24 * 1 -1
25 * 1 -1
26 * 2 INTERIOR SINGULARITY
27 * 1 -1
28 * 1
29 * 9 LEADING EDGE SINGULARITY
30 * -1 -1
31 * 1 -1
32 * 4 TRAILING EDGE SINGULARITY
33 * -1 -1
34 * 1 1
35 * 17 TIP SINGULARITY
36 *0
37 *FINISH
38 * $DATA FLT(1)=1.7437 ,1.0,3.4H74 ,1.0,INT(10)=1,FLT(5)=1.0,0.0,0.0 SEND
39 *STORE
40 * $DATA SS=30701 SEND
41 *PRINT
42 * $DATA PRINT=1,B,F,PRINT(5)=T SEND
43 *STOP
*****
UNIT 4 IS NOW THE INPUT FILE

```

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TABLE 2.- FOTFAN GEOMETRY INPUT FOR CANARD (TRAPEZOIDAL PLANFORM, STANDARD PANELS)

```

.....
*
*                               I N P U T
*
1  *TITLE
2  *IN 0-7505 CANARD II ANGLED HAKE
3  *CANV
4  *OSEGMENTS
5  *SDATA NHP5010,NAPV05 SEND
6  *SR11
7  *SINCRV1 IC01,COPY00 SEND
8  *SR11
9  *SINCRV1 IC02,COPY02 SEND
10 *SR11
11 *SINCRV1 IC04,COPY04,VAR20=00 SEND
12 *SR11
13 *SINCRV1 IC05,COPY00 SEND
14 *SR11
15 *SINCRV1 IC07,COPY00,VAR201 SEND
16 *SR11(DEFINE WING AS IN THE ZOO PLANE)
17 *SINCRV1 IC011,COPY00 SEND
18 *SL (DEFINE THE ROOT)
19 *SDATA I0PTS00,VAR20V03,A1 SEND
20 *SU (DEFINE THE LOCATION OF THE TIP)
21 *SDATA VAR20V01,17,25 SEND
22 *VL (DEFINE THE LEADING EDGE)
23 *SDATA I0PTS01,NTARS02,VAR10V04,A1,17,25,
24 *VAR20V05,04,07,00 SEND
25 *V11 (DEFINE THE TRAILING EDGE)
26 *SDATA VAR20V07,65,50,65 SEND
27 *VLRC (DEFINE THE SPANNWISE PANEL DISTRIBUTION)
28 *SDATA I0PTS00 SEND
29 *SLHC (DEFINE THE CHORDWISE PANEL DISTRIBUTION)
30 *SDATA I0PTS02 SEND
31 *NUM,PANEL ID THE CANARD
32 *PANEL
33 *SDATA N0101 SEND
34 *N0101--MOVE CANARD TO LEFT BY 3.01 UNITS
35 *SDATA PHI,0.0,RS010,0.0,-3.01,0.0 SEND
36 *LSPL (DEFINE THE DOUBLET SINGULARITY FLAGS)
37 * 1 -1
38 * 1 -1
39 * 2 INTERIOR SINGULARITY
40 * 1 -1
41 * 1
42 * 9 LEADING EDGE SINGULARITY
43 * 1 -1
44 * -1 -1 TRAILING EDGE SINGULARITY
45 * 6
46 * -1 -1
47 * 1
48 * 17 TIP SINGULARITY

49 *0
50 *OVN (DEFINE THE DIRECTIONS OF THE SHED VORTICES)
51 * 1 -1
52 * 1 -1
53 * .43000 0.0 .34202
54 * 1 1
55 * -1 -1
56 * .93000 0.0 .34202
57 *0
58 *FINISH
59 *SDATA INT(10)01,FL1010,1,25,4,53,31,25,4,FI(10)050,10 SEND
60 *STONE
61 *SDATA I0N0101 SEND
62 *PRINT
63 *SDATA SEND
64 *STOP
.....
UNIT 1 IS THE INPUT FILE

```

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TABLE 3.- POTFAN GEOMETRY INPUT FOR WING (TRAPEZOIDAL PLANFORM, STANDARD  
PANELS)

```

*****
*                               I N P U T                               *
*****
1  *TITLE
2  *TN D=7505 WING Y ANGLED MARK(WING GEOMETRY FILE),
3  *CANY
4  *DSEGMENTS
5  * SDATA NHP=17,NHPV=0 SEND
6  *SRI1
7  * SINCRI IC=1,COPI=0 SEND
8  *SRI1
9  * SINCRI IC=2,COPI=2 SEND
10 *SRI1
11 * SINCRI IC=4,COPI=4,VAR2=90 SEND
12 *SRI1
13 * SINCRI IC=5,COPI=0 SEND
14 *SRI1
15 * SINCRI IC=7,COPI=4,VAR2=1 SEND
16 *SRI1(DEFINE WING AS IN THE Z=0 PLANE)
17 * SINCRI IC=11,COPI=0 SEND
18 *NL (DEFINE THE ROOT)
19 * SDATA IPTSV=4,VAR2SV=1,RI SEND
20 *RII (DEFINE THE LOCATION OF THE MITHRANU CANARD VORTEX)
21 * SDATA VAR2SV=25,40 SEND
22 *VL (DEFINE THE LEADING EDGE)
23 * SDATA IPTSV=1,NTANSV=2,VARISV=1,RI,25,40,
24 * VAR2SV=47,65,85,04 SEND
25 *VLI (DEFINE THE TRAILING EDGE)
26 * SDATA VAR2SV=77,45,91,RI SEND
27 *VLHC (DEFINE THE SPANNWISE PANEL DISTRIBUTION)
28 * SDATA IPTSV=0 SEND
29 *BLHC (DEFINE THE CHORDWISE PANEL DISTRIBUTION)
30 * SDATA IPTSV=2 SEND
31 *AVLC (ADJUST THE PANELS SO THAT THEY MATCH CANARD)
32 * SDATA XADJ=214654479,NADJ=0 SEND
33 *AVHC (ADJUST THE PANELS SO THAT THEY MATCH CANARD)
34 * SDATA SEND
35 *GRID (PRINT OUT PANELS)
36 * NHP,PANEL UP THE CANARD
37 *PANEL
38 * SDATA NSI=1 SEND
39 *ROSS=MOVE CANARD TO LEFT BY 1.01 UNITS
40 * SDATA PHI=0.0,RSHT=0.0,-3,RI,0.0 SEND
41 *NSFL (DEFINE THE DOUBLE SINGULARITY FLAGS)
42 * 1 -1
43 * 1 -1
44 * 2 -1 INTERIOR SINGULARITY
45 * 111 -1
46 * 111 -1
47 * 9 -1 LEADING EDGE SINGULARITY
48 * 1 -1

49 * -1 -1
50 * 0 -1 TRAILING EDGE SINGULARITY
51 * -1 -1
52 * 1 -1
53 * 17 -1 TIP SINGULARITY
54 *0
55 *DVA (DEFINE THE DIRECTIONS OF THE SHED VAKES)
56 * 1 -1
57 * 1 -1
58 * .01949 0.0 .14202
59 * 1 1
60 * -1 -1
61 * .01949 0.0 .14202
62 *0
63 *FINISH
64 * SDATA IN(10)=1,FLT=516.1,25,4,51.31,25.4,FLT(10)=59.14 SEND
65 *STIME
66 * SDATA DU=8702 SEND
67 *PRINT
68 * SDATA SEND
69 *STOP
*****
UNIT 4 IS NOW THE INPUT FILE

```

TABLE 4.- PARTIAL LISTING OF CANARD POTGEM FILE FOR INPUT OF TABLE 2

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OF POOR QUALITY

TABLE 5.- POTWAK INPUT DECK FOR DELTA WING

\$DATA	
NSEGS	= 150,
ALPHA	= .2E+02,
MACH	= 0.0,
UINF	= .1E+01,
ID	= 30701,
PLOT	= T,
STORE	= T,
IDWAKE	= 30701,
DELTAT	= .1E+00,
R1	= .13429E+00,
R2	= .69487E-01,
THETA	= .95833E+00,
GAMO	= .22767E+00,
STASHN	= 1,
FACTR	= .5E+00, .1E+01, .1E+01, .1E+01,
XVAL	= .1E+01,
DELTAX	= .3E-01,
EPS	= .1E-01,
IFLAG	= 0,
ILINE	= 2,
IYLO	= 125,
IYHI	= 925,
IZLO	= 125,
IZHI	= 925,
IARGMIN	= 125,
IARGMAX	= 925,
IRKN	= 10,
VLB	= .1E-02, .1E-02, 0.0, -.5E+03, -1, -1, -1, -1, -1,
VUB	= .5E+03, .5E+03, .15707963268E+01, .5E+03, -1, -1, -1, -1, -1

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TABLE 5.- CONCLUDED.

IPRINT	= 1,
NCON	= 1,
NSIDE	= 1,
INFO	= 1,
ITMAX	= 500,
ICNDIR	= 0,
NSCAL	= 0,
SCAL	= -1, -1, -1, -1, -1, -1, -1, -1, -1,
ITRM	= 2,
CTL	= -.1E-01,
CTLMIN	= .1E-02,
PHE	= 0.0,
DELFUN	= .1E-08,
DABFUN	= .1E-08,
FDCH	= .1E-09,
FDCHM	= .1E-14,
THE	= 0.0,
NFDG	= 0,
LINOBJ	= 0,
CT	= -.5E-01,
CTMIN	= 0.0,
\$END	

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TABLE 6.- WAKE GEOMETRY OUTPUT FILES

1ST RECORD

NTITL=40

(TITL(NTITL))--ALPHANUMERIC TITLING INFORMATION FROM THE GEOMETRY  
FILE CORRESPONDING TO THE COMPONENT TO WHICH THE WAKE IS  
ATTACHED.

NRECS=5

(IFORM(NRECS))--1,1,0,0,1

NID=2

ID(1)--ID NUMBER OF SURFACE TO WHICH THE VORTEX IS ATTACHED.

ID(2)--ID NUMBER OF WAKE FILE

NLOG=1

LOG(1)--NOT USED.

NINT=4

INT(1)--NSEGS, THE NUMBER OF CORNER POINTS AND SEGMENTS DESCRIBING  
EACH SHED VORTEX LINE. THE FINAL SEGMENT IS AN INFINITE  
LENGTH SEGMENT DEFINED PARTLY BY DIRECTION VECTORS. THUS  
THE NUMBER OF CORNER POINTS IS REALLY NSEGS AND NOT NSEGS-1.

INT(2)--MLINES, THE NUMBER OF SHED VORTEX LINES.

INT(3)--N1, THE NUMBER OF N1 DIRECTION CORNER POINTS ON THE  
COMPONENT FROM WHICH THE WAKE IS SHED.

INT(4)--N2, THE NUMBER OF N2 DIRECTION CORNER POINTS ON THE  
COMPONENT FROM WHICH THE WAKE IS SHED.

NFLT=3

FLT(1)--NOT USED, BUT RESERVED FOR MACH NUMBER.

FLT(2)--ANGLE OF ATTACK CORRESPONDING TO THE WAKE GEOMETRY.

FLT(3)--UINF, THE FREE STREAM VELOCITY. USUALLY JUST 1.0.

TABLE 6.- CONTINUED.

RECORD 2

J1=NSEGS

J2=NLINES

J3=3

NW=NSEGS\*NLINES\*3

(XWAKE(NSEGS,NLINES)), (YWAKE(NSEGS,NLINES)), (ZWAKE(NSEGS,NLINES))--

X, Y, AND Z POINTS DEFINING, IN PART, THE GEOMETRY OF THE SHED  
WAKE. THE WAKE IS COMPOSED OF NLINES LINES AND EACH LINE IS  
REPRESENTED BY NSEGS-1 FINITE SEGMENTS AND ONE SEMIINFINITE  
SEGMENT.

RECORD 3

J1=NLINES

J2=1

J3=1

NW=NLINES

(I1INDX(NLINES))--ARRAY GIVING THE I1 INDEX OF THE CORNER POINT  
ON THE GENERATING SURFACE FROM WHICH THE WAKE IS SHED.

RECORD 4

J1=NLINES

J2=1

J3=1

NW=NLINES

(I2INDX(NLINES))--ARRAY GIVING THE I2 INDEX OF THE CORNER POINT  
ON THE GENERATING SURFACE FROM WHICH THE WAKE IS SHED. FOR  
EXAMPLE, THE 4TH VORTEX LINE ORIGINATES AT THE I1=I1INDX(4)  
AND I2=I2INDX(4) CORNER POINT CORRESPONDING TO THE GEOMETRY  
FILE WHOSE IDENTIFICATION NUMBER IS ID(1).

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TABLE 6.- CONCLUDED.

RECORD 5

J1=NLINES

J2=3

J3=1

NW=3\*NLINES

(UVWX(NLINES)), (UVWY(NLINES)), (UVWZ(NLINES))--ARRAYS THAT DEFINE  
THE DIRECTION OF THE FINAL SEGMENT IN EACH VORTEX LINE. NOTE  
THAT THE FINAL SEGMENT IN EACH LINE IS INFINITE IN LENGTH.  
ALSO, BY DEFINITION,  $UVWX(I)^2 + UVWY(I)^2 + UVWZ(I)^2 = 1$   
WHERE 1 .LE. I .LE. NLINES.

2008 年 12 月

~~ROTCAN NORTH INDIAN MATHS PROGRAM, VERSION 1.0~~  
~~\*\*\*\*\*~~

TIME = 08/28/78 13.05.39

[illegible]

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TABLE 8.- VVIM INPUT DECK TO CANARD-WING CASE

NOTES: VVIM INPUT DECK PROGRAM, VERSION 1.0  
\*\*\*\*\*

DYNAMIC MEMORY: 20000 WORDS

TIME: 04/21/78 13,24,29

```

*****
*                               I N P U T                               *
*****
1  *DATA
2  * *DATA INSTRUCTIONS SEND
3  *
4  *   SET UP IMAGE FACTORS
5  *   *****
6  *IMAGE
7  * *DATA SEND
8  *
9  *   COMPUTE INFLUENCE OF THE CANARD ON ITSELF
10 *   *****
11 *
12 *HEAD
13 * *DATA INSTRUCTIONS SEND
14 *COMP
15 * *DATA MACH20.3 SEND
16 *INF1
17 * *DATA INSTRUCTIONS SEND
18 *VIS1
19 * *DATA INSTRUCTIONS SEND
20 *VIS2
21 * *DATA INSTRUCTIONS SEND
22 *
23 *   COMPUTE INFLUENCE OF THE CANARD ON THE WING
24 *   *****
25 *
26 *HEAD
27 * *DATA INSTRUCTIONS SEND
28 *COMP
29 * *DATA SEND
30 *INF1
31 * *DATA INSTRUCTIONS SEND
32 *VIS1
33 * *DATA INSTRUCTIONS SEND
34 *VIS2
35 * *DATA INSTRUCTIONS SEND
36 *
37 *   COMPUTE INFLUENCE OF THE WING ON ITSELF
38 *   *****
39 *
40 *HEAD
41 * *DATA INSTRUCTIONS SEND
42 *COMP
43 * *DATA SEND
44 *INF1
45 * *DATA INSTRUCTIONS SEND
46 *VIS1
47 * *DATA INSTRUCTIONS SEND
48 *VIS2
49 *
50 *
51 *   COMPUTE INFLUENCE OF THE WING ON THE CANARD
52 *   *****
53 *
54 *HEAD
55 * *DATA INSTRUCTIONS SEND
56 *COMP
57 * *DATA SEND
58 *INF1
59 * *DATA INSTRUCTIONS SEND
60 *VIS1
61 * *DATA INSTRUCTIONS SEND
62 *VIS2
63 * *DATA INSTRUCTIONS SEND
64 *STOP
*****
ON 11 1 IS 00, THE INPUT FILE

```

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OF POOR QUALITY

TABLE 9.- INFMAN INPUT DECK FOR DELTA WING

INFMAN MATRIX MANIPULATION PROGRAM, VERSION 3.0  
\*\*\*\*\*

DYNAMIC MEMORY = 45000 WORDS

TIME = 04/20/70 13.06.36

```
*****
1  *****
2  * SDATA NINX801, IDGENM=30701,
3  * IDGENM=30701,
4  * IDIN=3201, IDOUT=3202,
5  * CONGR1=1, RAN, N=1, 135  100  11, 230  SEND
6  *VEA00
7  * S0A2A SEND
8  *VIA00
9  * S0A2A SEND
10 *V2A00
11 * S0A2A SEND
12 *STOP
*****
UNIT 4 IS NOW THE INPUT FILE
```

**ORIGINAL PAGE IS  
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**TABLE 10.- INFMAN INPUT DECK FOR CANARD-WING CASE**

NOTAN MAINI MANIPULATION PROGRAM, VERSION 0.0  
 #####

DYNAMIC MEMORY - 43000 WORDS

TIME = 09/21/18 13.27.21

```

0 *****
1 *                               T N P I I T
2 *****
3 *
4 *   COMPUTE SEMI-INDEPENDENT MAKE FOR CANARD
5 *   *****
6 *
7 *VNADD
8 *  DATA  INDEIMBNT01,A02,INMGCHNB01,IIDN=0001,0002,INDUITEV01,0002,NCOMP=2,
9 *  COMPT=1,PARAMC=1.0001,0.0,1,F30 SEND
10 *VNANI
11 *  DATA  SENR
12 *VNAND
13 *  DATA  SENR
14 *
15 *   COMPUTE SEMI-INDEPENDENT MAKE FOR KING
16 *   *****
17 *
18 *VNAND
19 *  DATA  INMGCHNB02,IIDN=0004,0003,INDUITEV04,0003,
20 *  COMPT=1,PARAMC=2.7107,0.0,1,F30 SEND
21 *VEADD
22 *  DATA  SENR
23 *VNAND
24 *  DATA  SENR
25 *VZADD
26 *  DATA  SENR
27 *STOP
*****
UNTIL * IS NOW THE INPUT FILE

```

**TABLE 11.- BCDN INPUT DECK FOR WING-ALONE CASE**

**DYNAMIC MEMORY = 10240 WORDS**

TIME = 04/20/78 13.09.36

[illegible]

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**TABLE 12.- BCDN INPUT DECK FOR CANARD-WING CASE (CANARD)**

OUTFALL BOUNDARY CONDITION PROGRAM, VERSION 1.2  
 \*\*\*\*\*

DYNAMIC MEMORY = 10000 WORDS

TIME = 04/21/1A 14.35.40

```

*****
*
*          I 4 P U Y
*****
1  *GREAT (HEAD IN GPNHFTWY OF THE CARABII)
2  * A701
3  *HCEAD
4  * SHCEAD A1 PHA10, NSEYS2 SFND
5  *CRCV
6  *SHCV
7  * AHO1
8  *RCHEAD
9  * SHCEAD A1 PHA20 SEND
10 *CRCV
11 *SHCV
12 *SYUP
*****
UNIT 4 IS NOW THE INPUT FILE

```

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OF POOR QUALITY

TABLE 13.- BCDN INPUT DECK FOR CANARD-WING CASE (WING)

BOFFAN BOUNDARY CONDITION PROGRAM, VERSION 1.2  
\*\*\*\*\*

DYNAMIC MEMORY = 10000 WORDS

TIME = 00/21/70 11.30.00

```

*****
*                                     I N P U T
*****
1 *CREAD (READ IN GEOMETRY OF THE WING)
2 * AT02
3 *ACHFAD
4 * BDCREAD ALPHA01, NSETS=2 SPNO
5 *CRCV
6 *SRCV
7 * AB02
8 *HCREAD
9 * BDCREAD ALPHA02 SPNO
10 *CRCV
11 *SRCV
12 *STOP
*****
UNTIL I IS NOW THE INPUT FILE

```

**TABLE 14.- PSOLVE INPUT DECK FOR WING-ALONE CASE**

(LU DECOMPOSITION METHOD USING PARTITIONING AND RANDOM I/O)

SCRATCH MEMORY AVAILABLE = 42000 WORDS

TIME OF RUN 18--  
04/20/78 11,10,17

```

*****
***** I N P U T *****
*****
1 * DATA IDIN=JZ02,
2 * ISOC=JZ01,
3 * IOS=JZ01,
4 * SEND
*****
UNIT 4-SS-MO, THE (HNP) FILE

```

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TABLE 15.- PSOLVE INPUT DECK FOR CANARD-WING CASE

TIME OF RUN IS--  
00/21/70 13.16.13

```

.....
*                               I N P U T                               *
*.....*.....*.....*.....*.....*.....*.....*.....*.....*.....*.....*
1 * QUATA NCOMP=2, IDIN=0001, 9902, IDYN(1,2)=9901a, 9901,
2 * IDHC=0001, 0002, IDS=0003, 0004,
3 * END
*.....*.....*.....*.....*.....*.....*.....*.....*.....*.....*.....*
UNIT 4 IS NOW THE INPUT FILE

```

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TABLE 16.- POTFOR INPUT DECK FOR WING-ALONE CASE

```

POTFOR FORCE PROGRAM, VERSION 1.0
*****
DYNAMIC MEMORY = 25000 WORDS

TIME = 04/20/78 13.11.10

*****
      INPUT
*****
1.  READ IN WING GEOMETRY
2.  * SDATA IDG=10701 SEND
3.  * ATTITUDE
4.  * SDATA IDBF=3201 SEND
5.  * CALCULATE FORCES & PRESSURES MODIFIED
6.  * KUTTA JOURNISKII METHOD
7.  * SPANLOADS
8.  * SDATA IDVE=3202, IDB=3201, PRINT=1, T SEND
9.  * PRESSURES
10. * SDATA SEND
11. * SPANLOADS
12. * SDATA IDV1=3202, IDV2=3202,
13. * IDB=3201, PRINT=1 SEND
14. * PRESSURES
15. * SDATA SEND
16. * SPANLOADS
17. * SDATA SEND
18. * STOP
*****
UNIT 4 IS NOW THE INPUT FILE

```

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TABLE 17.- POTFOR INPUT FOR CANARD-WING CASE

```

.....
*
*                               I N P U T
*
1 * CALCULATE LOADS ETC. ON THE CANARD
2 * .....
3 *
4 *HEAD
5 * $DATA IUG=8701 SEND
6 *ATTITUDE
7 * $DATA INSP=8803 SEND
8 *COMMONS
9 * $DATA NCON=01,ALPHA=40 SEND
10 *MFTLOADS
11 * $DATA NCONP=2,INSP=8803,AR04,
12 * IDVE=9901,9904 SEND
13 *PRESSURES
14 * $DATA PUPY=0 SEND
15 *SPANLOADS
16 * $DATA SEND
17 * DRIP FORCES ON PANELS
18 *DROP
19 *=-1
20 *0
21 *METH (CALCULATE LOADS BY METHOD JUKOWSKI LAW)
22 * $DATA
23 * IDVE=9901,9902,INVE=9901,9904 SEND
24 *PRESSURES
25 * $DATA SEND
26 *SPANLOADS
27 * $DATA SEND
28 *
29 * CALCULATE LOADS ETC. ON THE WING
30 * .....
31 *HEAD
32 * $DATA IUG=8702 SEND
33 *ATTITUDE
34 * $DATA INSP=8804 SEND
35 *COMMONS
36 * $DATA NCON=01 SEND
37 *MFTLOADS
38 * $DATA JCONP=2,
39 * IDVE=9902,9903 SEND
40 *PRESSURES
41 * $DATA SEND
42 *SPANLOADS
43 * $DATA SEND
44 * DRIP FORCES ON PANELS
45 *DROP
46 *=-1
47 *0
48 *METH
49 * $DATA IDVE=9902,9903,INVE=9902,9903 SEND
50 *PRESSURES
51 * $DATA SEND
52 *SPANLOADS
53 * $DATA SEND
54 *STOP
.....
UNIT 1 IS IN THE INPUT FILE

```

**TABLE 18.- POTFOR OUTPUT FOR DELTA WING**

13#	1	(A(=, 12, 13))=			
12#	1				
		.8972297	.9018402	.9451069	.9341141
		.9582500	.9661864	.9248962	.8813755
		.8590019	.8897948	.8674416	.8028042
		.6664448			
12#	2	(A(=, 12, 13))=			
		.8650827	.8848800	.9623116	.9728604
		.9951169	.9861044	.9204409	.9134774
		.8226490	.9114125	.8316614	.8806539
		.8295803			
12#	3	(A(=, 12, 13))=			
		.9036554	.9052405	.9750861	1.004524
		1.008062	.9897732	.9011346	.9309544
		.8142059	.9407517	.9379424	.8721254
		.8544196			
12#	4	(A(=, 12, 13))=			
		.9204108	.9166470	.9038404	1.021473
		.9947317	.9436000	.9040655	.9555738
		.8597412	.9405972	.9017804	.8872387
		.9185817			

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TABLE 18.- CONTINUED.

12a	5	(A(0,12,13))			
		.9351404	1.007249	1.021703	.970550
		.9351404	.9351404	.9351404	.9351404
		.9165500	.9553739	.9331762	.9281593
		.9351404			.970550
12a	6	(A(0,12,13))			
		.9351404	1.013259	1.014000	.970550
		.9351404	.9351404	.9351404	.9351404
		.9165500	.9553739	.9331762	.9281593
		.9351404			.970550
12a	7	(A(0,12,13))			
		.9351404	1.011635	1.011692	.970550
		.9351404	.9351404	.9351404	.9351404
		.9165500	.9553739	.9331762	.9281593
		.9351404			.970550
12a	8	(A(0,12,13))			
		.9351404	1.011635	1.011692	.970550
		.9351404	.9351404	.9351404	.9351404
		.9165500	.9553739	.9331762	.9281593
		.9351404			.970550
V COMPONENT					
13a	1	(A(0,12,13))			
		.2212535	.2020082	.4720250	.5707217
		.6397120	.6520712	.5920514	.5711300
12a	2	(A(0,12,13))			
		.3050575	.3050575	.5300051	.6007407
		.6172401	.6421301	.6500000	.6007407
		.7103357	.6007407	.7400000	.7400000
12a	3	(A(0,12,13))			
		.2000250	.3575170	.5350000	.6007407
		.6350171	.6420007	.6500000	.6007407
		.6343045	.6000302	.6000000	.6007407
12a	4	(A(0,12,13))			
		.2235200	.2041007	.4521125	.5232010
		.7100007	.6277037	.6717750	.6500000
		.6201002	.6220000	.6000000	.6007407
12a	5	(A(0,12,13))			
		.1015020	.2070037	.3010000	.4100000
		.4000000	.4000000	.4100000	.4100000
		.3900000	.3972000	.3850000	.3500000
12a	6	(A(0,12,13))			
		.1001003	.1300204	.2370000	.2400000
		.2010013	.2000737	.2500000	.2500000
		.2275707	.2311017	.2202219	.2175500
12a	7	(A(0,12,13))			
		.1914153			
		.5900000	.7505700E=01	.1417104	.1500000
		.1510525	.1203020	.1331000	.1310000
		.1103175	.1100770	.1177400	.1122000
12a	8	(A(0,12,13))			
		.9900277E=01			

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TABLE 18.- CONTINUED.

	.1933801E-01	.205231E-01	.5009570E-01	.4041043E-01	.4101270E-01
	.4679450E-01	.4051024E-01	.4130201E-01	.3953030E-01	.40100320E-01
	.3310241E-01	.3934000E-01	.3692994E-01	.3072100E-01	.3072100E-01
	.3083099E-01				
N COMPONENT					
13#	1				
12#	1	(A(-,12,13))=			
		.1129795E-10	.4791001E-11	.1037510E-11	.1101107E-11
		.1010000E-11	.0059557E-12	.9530032E-12	.1120346E-11
		.0601209E-12	.0170017E-12	.7000952E-12	.7719301E-12
		.4190023E-12			.5051400E-12
12#	2	(A(-,12,13))=			
		.1000000E-11	.1070000E-11	.0000000E-12	.0000000E-12
		.4145295E-13	.2710034E-12	.2000107E-12	.1032507E-13
		.3013030E-13	.1100000E-13	.5100000E-13	.1000000E-13
		.1090121E-12			.0000000E-13
12#	3	(A(-,12,13))=			
		.6000300E-11	.1011547E-11	.5010002E-12	.3007023E-12
		.0200017E-12	.0000000E-12	.1100000E-12	.0000000E-12
		.1003000E-12	.2312595E-12	.2001201E-12	.2001201E-12
		.3000000E-12			.5100000E-12
12#	4	(A(-,12,13))=			
		.4013015E-11	.1000000E-11	.0030000E-12	.0015000E-12
		.3000010E-12	.3395750E-12	.3000100E-12	.1500023E-12
		.3300107E-12	.0000000E-12	.1100000E-12	.1000000E-12
		.4529710E-13			.0000000E-12
12#	5	(A(-,12,13))=			
		.2003000E-11	.4132111E-12	.7710000E-13	.2300000E-12
		.0035290E-12	.1311000E-12	.1001000E-14	.4000000E-12
		.6505007E-13	.2315370E-12	.1000121E-13	.2100021E-12
		.0001330E-13			.1501022E-12
12#	6	(A(-,12,13))=			
		.1337190E-11	.2010100E-12	.3000000E-12	.3012500E-12
		.1050300E-12	.4700000E-12	.2510000E-12	.4070575E-13
		.1003290E-14	.2000730E-12	.3500000E-12	.1500000E-12
		.3019007E-13			.0000000E-12
12#	7	(A(-,12,13))=			
		.1000300E-11	.7050275E-12	.0000000E-12	.2000000E-12
		.3200007E-12	.5000000E-12	.4000000E-12	.5131000E-12
		.4171100E-12	.5500000E-12	.2000000E-12	.4720000E-12
		.3330000E-12			.5000000E-12
12#	8	(A(-,12,13))=			
		.6700000E-11	.1000000E-11	.0000000E-12	.0000000E-12
		.7250000E-12	.0001000E-12	.5700000E-12	.0000000E-12
		.0000000E-12	.0001200E-12	.4000000E-12	.5000000E-12
		.3000000E-12			.5000000E-12

ENTER FORSC

PA3LA 1 FRI8U 0 FFI8U 0 FFI8U 0

EXIT FORSC

EXIT KUTTAC

NORMF = .57340315 NORMM = .57340315 .10000000 .57340315 .10000000

COMBINATION 1

FX = .00000000

FY = .00000000

**TABLE 18.- CONTINUED.**

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OF POOR QUALITY

TABLE 18.- CONTINUED.

10	3	2.82866	.38583	2.21604
11	3	2.28861	.43756	2.16712
12	3	2.80057	.42813	1.80007
13	3	2.72453	.52083	1.92378
14	3	2.80240	.60360	1.70903
15	3	3.16046	.60417	1.46165
16	3	3.37442	.66503	1.19210
1	4	.16898	.01705	.40095
2	4	.32000	.05110	.78721
3	4	.50001	.08523	1.19064
4	4	.70207	.11932	1.61962
5	4	.90083	.15341	1.08060
6	4	1.10070	.18756	1.50253
7	4	1.41676	.22159	1.00418
8	4	1.63092	.25560	1.01200
9	4	1.85260	.28977	1.51922
10	4	2.07064	.32306	1.64067
11	4	2.28861	.35795	1.42005
12	4	2.50657	.39205	1.33150
13	4	2.72453	.42614	1.22257
14	4	2.94249	.46023	1.10320
15	4	3.16046	.49432	.88013
16	4	3.37842	.52841	.69100
1	5	.16898	.01326	.29006
2	5	.32000	.03077	.52110
3	5	.50001	.06629	.88007
4	5	.70207	.10000	1.00000
5	5	.90083	.11932	1.15011
6	5	1.10070	.14603	1.10014
7	5	1.41676	.17235	.98005
8	5	1.63092	.19000	1.67012
9	5	1.85260	.22518	.92002
10	5	2.07064	.25100	.90000
11	5	2.28861	.27841	.77207
12	5	2.50657	.30492	.77070
13	5	2.72453	.33144	.65020
14	5	2.94249	.35705	.56031
15	5	3.16046	.38447	.42200
16	5	3.37842	.41000	.20000
1	6	.16898	.00947	.23335
2	6	.32000	.02041	.39202
3	6	.50001	.04735	.65700
4	6	.70207	.06029	.77017
5	6	.90083	.08523	.84111
6	6	1.10070	.10417	.81017
7	6	1.41676	.12311	.73117
8	6	1.63092	.14205	.74055
9	6	1.85260	.16090	.67007
10	6	2.07064	.17992	.62050
11	6	2.28861	.19800	.54201
12	6	2.50657	.21740	.52020
13	6	2.72453	.23670	.43000
14	6	2.94249	.25560	.34010
15	6	3.16046	.27402	.25100
16	6	3.37842	.29350	.12022
1	7	.16898	.00568	.19703
2	7	.32000	.01705	.31007
3	7	.50001	.02001	.52225
4	7	.70207	.03977	.64001
5	7	.90083	.05114	.72000

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

7	7	1.41676	.06356	.64463
8	7	1.41676	.07386	.64462
9	7	1.41676	.08416	.64462
10	7	1.85266	.09659	.59220
11	7	2.28861	.11932	.53370
12	7	2.72455	.14205	.47452
13	7	3.16046	.16477	.41534
14	7	3.59642	.18750	.35616
15	7	4.03237	.21023	.29698
16	7	4.46832	.23296	.23780
1	8	1.41676	.00189	2.01431
2	8	1.41676	.00378	1.60891
3	8	1.41676	.00567	1.20351
4	8	1.41676	.00756	1.00770
5	8	1.41676	.00945	1.73799
6	8	1.41676	.01134	1.70400
7	8	1.41676	.01323	1.50675
8	8	1.41676	.01512	1.50690
9	8	1.85266	.03220	1.43379
10	8	2.28861	.05977	1.37700
11	8	2.72455	.08735	1.22917
12	8	3.16046	.11492	1.15730
13	8	3.59642	.14250	1.04033
14	8	4.03237	.17007	.91000
15	8	4.46832	.19765	.77174
16	8	4.90427	.22523	.63247

EXIT PRESS

SPANLOADS

"SPANWISE" LOAD DISTRIBUTIONS

REFERENCE CHORD = 3.4874

IL	S	FxRn	FyRn	FzRn	FxRnI	FyRnI	FzRnI
COMBINATION 1							
1	.1090	.67983E-02	.32345E-11	.14670E-01	-.15863E-14	.12745E-11	.57716E-15
2	.3269	.22617E-01	.87237E-12	.62139E-01	-.67450E-14	.87237E-12	.30155E-14
3	.5449	.58384E-01	.66657E-12	.10000	.31028E-14	.66657E-12	-.10260E-14
4	.7629	.94227E-01	.55854E-12	.25000	.10494E-14	.55854E-12	-.00041E-15
5	.9809	.13067	.43368E-12	.37305	.00041E-14	.43368E-12	-.10260E-14
6	1.199	.17106	.70989E-12	.47164	-.28084E-14	.70989E-12	.10222E-14
7	1.417	.10434	.60340E-12	.53405	.19325E-13	.60340E-12	-.70540E-14
8	1.635	.22403	.75611E-12	.61951	.11080E-13	.75611E-12	-.38071E-14
9	1.853	.23231	.80221E-12	.63025	-.35516E-14	.80221E-12	.12426E-14
10	2.071	.25338	.80828E-12	.63617	.93032E-14	.80828E-12	-.34079E-14
11	2.289	.25442	.80210E-12	.60014	.11051E-14	.80210E-12	.02001E-15
12	2.507	.26163	.11948E-11	.71081	.19550E-13	.11948E-11	-.71147E-14
13	2.725	.26311	.80427E-12	.72209	.01204E-14	.80427E-12	-.59140E-14
14	2.942	.24520	.10144E-11	.67389	.31951E-14	.10144E-11	-.11622E-14
15	3.160	.22068	.73273E-12	.60632	-.40774E-14	.73273E-12	.61545E-14
16	3.378	.18334	.79254E-12	.50373	-.41740E-14	.79254E-12	.29734E-14

GROUP FORCES ON PANELS

GROUPS 20 THROUGH 24 DROPPED

1. CALCULATE FORCES & PRESSURES BY KITTA JOHNSON

NETX

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

ENTER NUTAL

ENTER VERY

EXIT VERT

FILE PF32018011 ATTACHED AS TAPE 7

CREATION TIME = 04/20/70 15:10:37

MACH NO. = 0.000000

UNIT 7 REMOVED AND RETURNED

FILE PF3202V111 ATTACHED AS TAPE 7

CREATION TIME = 04/20/70 15:00:15

ENTER VELRDI

UNIT 7 REMOVED AND RETURNED

EXIT VELRDI

ENTER XPANDV

EXIT XPANDV

VELOCITY AT HI FORCE SENSING LOCATIONS

U COMPONENT

13a

12a

12b

12c

12d

12e

12f

12g

12h

12i

12j

12k

12l

12m

12n

12o

12p

12q

12r

12s

12t

12u

12v

12w

12x

12y

12z

12aa

12ab

12ac

12ad

12ae

12af

12ag

12ah

12ai

12aj

12ak

12al

12am

12an

12ao

12ap

12aq

12ar

12as

12at

12au

12av

12aw

12ax

12ay

12az

12ba

12bb

12bc

12bd

12be

12bf

12bg

12bh

12bi

12bj

12bk

12bl

12bm

12bn

12bo

12bp

12bq

12br

12bs

12bt

12bu

12bv

12bw

12bx

12by

12bz

12ca

12cb

12cc

12cd

12ce

12cf

12cg

12ch

12ci

12cj

12ck

12cl

12cm

12cn

12co

12cp

12cq

12cr

12cs

12ct

12cu

12cv

12cw

12cx

12cy

12cz

12da

12db

12dc

12dd

12de

12df

12dg

12dh

12di

12dj

12dk

12dl

12dm

12dn

12do

12dp

12dq

12dr

12ds

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12dv

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12ea

12eb

12ec

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12ee

12ef

12eg

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12ei

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12en

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12ep

12eq

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12es

12et

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12ez

12fa

12fb

12fc

12fd

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12ff

12fg

12fh

12fi

12fj

12fk

12fl

12fm

12fn

12fo

12fp

12fq

12fr

12fs

12ft

12fu

12fv

12fw

12fx

12fy

12fz

12ga

12gb

12gc

12gd

12ge

12gf

12gg

12gh

12gi

12gj

12gk

12gl

12gm

12gn

12go

12gp

12gq

12gr

12gs

12gt

12gu

12gv

12gw

12gx

12gy

12gz

12ha

12hb

12hc

12hd

12he

12hf

12hg

12hh

12hi

12hj

12hk

12hl

12hm

12hn

12ho

12hp

12hq

12hr

12hs

12ht

12hu

12hv

12hw

12hx

12hy

12hz

12ia

12ib

12ic

12id

12ie

12if

12ig

12ih

12ii

12ij

12ik

12il

12im

12in

12io

12ip

12iq

12ir

12is

12it

12iu

12iv

12iw

12ix

12iy

12iz

12ja

12jb

12jc

12jd

12je

12jf

12jg

12jh

12ji

12jj

12jk

12jl

12jm

12jn

12jo

12jp

12jq

**TABLE 18.- CONTINUED.**

51

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

	0.	0.	0.	0.	0.
12a	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12b	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12c	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12d	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12e	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12f	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12g	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12h	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12i	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12j	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12k	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12l	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12m	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12n	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12o	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12p	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12q	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12r	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12s	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12t	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12u	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12v	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12w	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12x	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12y	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
12z	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00

ENTER FORB1  
EXIT FORB1  
EXIT KUTTA1

NET FORCES CAUSED BY NI VORTEX SEGMENTS

NORMF	0.57349315	NURM	0.57349315	0.1644719	0.57349315	0.00000000
COMBINATION	1					
FX	0.00168283					
FY	0.0039250					
FZ	0.51328790					
MOMX	0.22475148					

1. **Journal** 2-2 200-0000 100-0000 100-0000

**TABLE 18.- CONTINUED.**

```

MMNV 0 -33778527
MMNZ 0 -09080657

PMM 0 -17000079
PMN 0 -00000000
PZM 0 -00191000
MMNM 0 -00000000
MMNV 0 -33778527
MMNM 0 -00000001

ENTER KUTAS
ENTER VERT
EXIT VERT
FILE PF32018011 ATTACHED AS TAPE 7
CREATION TIME = 08/30/78 13:10:55
UNIT 7 REBOUND AND RETURNED
FILE PF32020011 ATTACHED AS TAPE 7
CREATION TIME = 08/20/78 13:00:45
ENTER VELNO1
UNIT 7 REBOUND AND RETURNED
EXIT VELNO1
ENTER XPMOV
EXIT XPMOV

VELOCITY AT M2 FORCE SENSING LOCATIONS
*****

U COMPONENT

13# 1
12# 1 (A(0,12,13))=
.0400007 .0250000 .9240500 .0007400 .4357420
.0120741 .0033000 .0070000 .0000000 .0000000
.0930210 .0913300 .0973117 .0079070 .0073512
.0000100 0.

12# 2 (A(0,12,13))=
.0400007 .0050000 .0000742 .0073123 .0020000
.0500291 .0000302 .0701743 .0500475 .0200154
.0073117 .0000742 .0000000 .0000000 .0000000
.0200000 0.

13# 3 (A(0,12,13))=
.0400007 .0355100 .0330007 .0021037 .0007400
.0001100 .0001170 .0000000 .0000000 .0000000
.0710070 .0070510 .0730740 .0010550 .0000000
.0000000 0.

12# 4 (A(0,12,13))=
.0400007 .0050000 .0000742 .0000000 .0000000
.0010033 .0000230 .0000254 .0000000 .0000000
.0700000 .0000000 .0000000 .0000000 .0000000
.0000007 0.

13# 5 (A(0,12,13))=
.0400007 .0000707 .0740000 .0521005 .0750045
.005107 .0200002 .0730100 .0000000 .0000000
.0102152 .0570007 .0330007 .0330310 .0210002
.0370110 0.

12# 6 (A(0,12,13))=
.0400007 .0000000 .0000000 .0000000 .0000000
.0000000 .0000000 .0000000 .0000000 .0000000
.0000000 .0000000 .0000000 .0000000 .0000000
.0000000 0.

```

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

12a	2	(A(•,12,13))=				
	0	.9490997	.9848336	1.0037788	.9761218	.9851221
	1	.9658210	.9950000	.9990175	.9991772	.9991032
	2	.9648775	.9715895	.9675635	.9636497	.9649611
12a	3	.9768023	0.			
	0	.9400007	.9675430	1.000013	.9817932	.9600075
	1	1.0000002	.981512	.9801467	.9833327	.9821306
	2	.9745061	.9730363	.9711207	.9601704	.9700000
	3	.9789494	0.			
V COMPONENT						
13a	1					
12a	1	(A(•,12,13))=				
	0	.6680284	.2279680	.3180924	.3498870	.5140004
	1	.6811724	.6330350	.8740090	.6840007	.8980000
	2	.6604023	.6663021	.6121647	.6144572	.5742095
12a	2	(A(•,12,13))=				
	0	.7013739	.7824570	.5791913	.6003300	.6049070
	1	.6861781	.8217083	.8391803	.8206109	.8175723
	2	.7250660	0.	.7706128	.7300203	.7300944
12a	3	(A(•,12,13))=				
	0	.7436204	.2750043	.3905555	.5212097	.6593474
	1	.8563073	.8073944	.6142853	.7065517	.7749114
12a	4	(A(•,12,13))=				
	0	.6120111	.7284020	.5203540	.4810538	.5001007
	1	.6887551	.6506697	.6890355	.6330001	.6158170
	2	.5545577	.5887020	.6510152	.6004000	.6000000
12a	5	(A(•,12,13))=				
	0	.4311893	.1654104	.2596554	.3240004	.4272295
	1	.4330055	.4258007	.4002264	.4070211	.4200506
	2	.3384004	.3700160	.3971725	.3820510	.3602425
12a	6	(A(•,12,13))=				
	0	.2623380	.1000002	.1570000	.2251012	.2857720
	1	.2478009	.2560057	.2710741	.2407200	.2400013
	2	.1956239	.2245019	.2307011	.2220022	.2110253
12a	7	(A(•,12,13))=				
	0	.1395780	.0171000E-01	.0423001E-01	.1412100	.1500911
	1	.1274503	.1340000	.1000002	.1201000	.1200721
	2	.1012352	.1177517	.1100134	.1153000	.1087105
12a	8	(A(•,12,13))=				
	0	.030843E-01	.4006000E-01	.2007000E-01	.4000710E-01	.0000000E-01
	1	.3034707E-01	.105413E-01	.4321009E-01	.3927304E-01	.4010307E-01
	2	.3136950E-01	.3665040E-01	.3714104E-01	.3570210E-01	.3357570E-01
	3	0.	0.			
W COMPONENT						
13a	1					
12a	1	(A(•,12,13))=				
	0	.3050505	-.2107750	-.1207579	.1425270E-01	.0210100E-01

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

12#	7	(A(.,12,13))=				
		.9490997	.9440530	1.003748	.478521n	.4441121
		1.005910	.9734504	.9454415	.4741772	.4401452
		.9048775	.9715045	.9675035	.4030497	.4049011
		.9745023	0.			
12#	8	(A(.,12,13))=				
		.0400907	.9075430	1.000013	.4017052	.4000075
		1.000042	.4011512	.9081407	.4033327	.4021301
		.9715051	.9730243	.9711207	.4001104	.4700020
		.9709494	0.			
V COMPONENT						
13#	1					
12#	1	(A(.,12,13))=				
		0.	.2279080	.3140024	.3440014	.5100000
		.0000704	.6330359	.0740000	.0000000	.0500000
		.0011724	.0003021	.0121047	.0140072	.5740005
		.5004073	0.			
12#	2	(A(.,12,13))=				
		0.	.2714075	.3791913	.4004300	.0140070
		.7013739	.7024570	.4391003	.0200109	.0115723
		.0001701	.0217003	.7700120	.7700203	.7300005
		.7750000	0.			
12#	3	(A(.,12,13))=				
		0.	.2750043	.3905555	.5212097	.0540000
		.7430204	.0000327	.0010000	.4272150	.0550070
		.0503473	.0073944	.0100053	.7000517	.7740100
		.7407530	0.			
12#	4	(A(.,12,13))=				
		0.	.2204020	.3200540	.4410530	.5001007
		.0120111	.0500047	.0000355	.0330000	.0150170
		.0047951	.5907470	.0310152	.0004000	.5000021
		.5505577	0.			
12#	5	(A(.,12,13))=				
		0.	.1654104	.2300554	.3240000	.0210005
		.4311093	.4250007	.4000000	.4010011	.0200000
		.0130055	.3700100	.3971725	.3000010	.3000000
		.1100004	0.			
12#	6	(A(.,12,13))=				
		0.	.1000002	.1470000	.2251012	.2007720
		.2020380	.2500057	.2710701	.2007204	.2100000
		.2470009	.2245019	.2307941	.2220022	.2110005
		.1950234	0.			
12#	7	(A(.,12,13))=				
		0.	.0171004E-01	.0423001E-01	.1412100	.1510011
		.1395780	.1340009	.1000000	.1201000	.1200000
		.1274500	.1177517	.1190134	.1151000	.1007115
		.1012352	0.			
12#	8	(A(.,12,13))=				
		0.	.1045000E-01	.2007000E-01	.4000100E-01	.0000000E-01
		.4303040E-01	.4105010E-01	.7321000E-01	.5007000E-01	.0010000E-01
		.3030000E-01	.3005000E-01	.5711000E-01	.5510000E-01	.5575000E-01
		.5130000E-01	0.			
W COMPONENT						
13#	1					
12#	1	(A(.,12,13))=				
		.3050505	.2107750	.1207474	.1250000E-01	.4210000E-01

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE 18.- CONTINUED.

	- .1999053E-01	.9095855E-01	- .1442022E-01	- .1418442E-01	.1154074E-01
	.8719008E-02	- .1275365E-01	.1437464E-01	- .1210901E-01	.1960574E-01
	- .4830187E-01	0.			
12	2 (A(.,12,13))=				
	.3650565	- .2216397	- .1166107	.5171702E-01	.7534941E-01
	- .5058863E-01	.1364078	- .1170885E-01	- .1248654E-01	.4351107E-01
	.4472052E-01	- .5042043E-01	.6198490E-01	- .3786504E-01	.4413043E-01
	.3704195E-01	0.			
12	3 (A(.,12,13))=				
	.3650565	- .1744470	- .9434994E-01	.4944483E-01	.8081520E-01
	- .6376460E-01	.1214458	.4076942E-01	- .5291754E-01	.3013570E-01
	.8423755E-01	- .8654202E-01	.7563917E-01	- .2163177E-01	.1541250E-01
	.3072336E-01	0.			
12	4 (A(.,12,13))=				
	.3650565	- .1112491	- .6643469E-01	.1804504E-01	.8011514E-01
	- .3986296E-01	.4588702E-01	.5665423E-01	- .4107420E-01	.1165545E-01
	.6289800E-01	- .5013177E-01	.2014731E-01	.1309075E-01	.3034793E-01
	.5533505E-02	0.			
12	5 (A(.,12,13))=				
	.3650565	- .6217780E-01	- .5015990E-01	.5517103E-01	.4215034E-01
	- .1632400E-01	.1121243E-01	.3673711E-01	- .1450112E-01	.1488700E-01
	.2097462E-01	- .8370462E-02	.7939504E-02	.4554547E-01	.6226470E-01
	.3428370E-02	0.			
12	6 (A(.,12,13))=				
	.3650565	- .3761082E-01	- .4776737E-01	.3823104E-02	.1304718E-01
	- .3633279E-02	- .9130028E-02	.1560299E-01	- .2704863E-02	.2118922E-02
	.6237982E-02	.6220092E-03	.6573803E-02	.8019011E-02	.7182102E-02
	.6209513E-02	0.			
12	7 (A(.,12,13))=				
	.3650565	- .2300144E-01	- .5788001E-01	- .2350846E-01	.6890071E-01
	.2565374E-02	- .7712402E-02	.6477976E-02	.1448780E-01	.4784146E-01
	.3669326E-02	.3013895E-02	.6058557E-02	.5632623E-02	.0241110E-01
	.7161079E-02	0.			
12	8 (A(.,12,13))=				
	.3650565	- .1584274E-01	- .3518444E-01	- .1178080E-01	.2282444E-01
	.4331600E-02	- .4302824E-02	.3518295E-02	.3100570E-02	.5745570E-01
	.3314903E-02	.3400330E-02	.5771127E-02	.5819444E-01	.5424180E-01
	.7440254E-02	0.			

ENTER FORS2  
EXIT FORS2  
EXIT KUTFA2

NET FORCES CAUSED BY N1 AND N2 VORTICX SEGMENTS

NORMF =	.57349315	NORMM =	.57349315	.10444719	.57349315	2.00000000
COMBINATION						
FX	=	.00250227				
FY	=	.04639250				
FZ	=	.94809022				
MOMX	=	.35237814				
MOMY	=	-.56326181				
MOMZ	=	.09207027				
FXM	=	.12123654				
FYM	=	.04639250				
FZM	=	.88888882				

ORIGINAL PAGE IS  
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TABLE 18.- CONTINUED.

MUMH 0 .30201702  
MUMVH 0 -.50120101  
MUMZH 0 -.03400207  
+PRESSURE  
ENTER FPA1  
EXIT FPA1  
ENTER FPA2  
EXIT FPA2  
ENTER PRESS

COMPUTATION OF PRESSURE

-----  
NCOMB 1 POTS 0  
11 12 3

			V	PRESSURE FOR EACH COMPUTATION
1	1	.10000	.02001	.51774
2	1	.12000	.00523	.75007
3	1	.50001	.14005	.40012
4	1	.70007	.10000	1.20070
5	1	.90003	.25500	1.30027
6	1	1.10010	.31250	1.20055
7	1	1.40070	.30732	1.40000
8	1	1.00072	.42014	1.20034
9	1	1.00000	.40200	1.20071
10	1	2.00000	.50077	1.10032
11	1	2.00001	.50000	1.00005
12	1	2.50007	.00001	.00000
13	1	2.70003	.71023	.00002
14	1	2.90000	.70700	.71000
15	1	3.10000	.02000	.00000
16	1	3.30002	.00000	.50000
1	2	.10000	.02000	.50000
2	2	.12000	.07000	.00000
3	2	.50001	.12001	1.20000
4	2	.70007	.17005	1.00000
5	2	.90003	.22000	2.00000
6	2	1.10010	.27000	2.00001
7	2	1.40070	.32000	2.31700
8	2	1.00072	.36000	2.00000
9	2	1.00000	.41000	2.00000
10	2	2.00000	.40700	1.90000
11	2	2.00001	.51700	1.00000
12	2	2.50007	.50000	1.00000
13	2	2.70003	.01000	1.07000
14	2	2.90000	.00000	1.30000
15	2	3.10000	.71000	1.23000
16	2	3.30002	.70000	1.00000
1	3	.10000	.02000	.50000
2	3	.12000	.00000	.00000
3	3	.50001	.10000	1.30000
4	3	.70007	.10000	1.00000
5	3	.90003	.20000	2.13000
6	3	1.10010	.20000	2.25000
7	3	1.40070	.27000	2.30000
8	3	1.00072	.31250	2.41000
9	3	1.00000	.35000	2.11000
10	3	2.00000	.30000	2.10000
11	3	2.00001	.40000	2.10000
12	3	2.50007	.47000	1.00000
13	3	2.70003	.50000	1.00000

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OF POOR QUALITY

TABLE 18.- CONTINUED.

14	3	2.94249	.50250	1.03821
15	3	3.16044	.00417	1.40047
16	3	3.37842	.04543	1.14220
1	4	.10490	.01705	.41179
2	4	.32694	.05114	.74414
3	4	.54891	.08523	1.15904
4	4	.76287	.11932	1.37804
5	4	.98083	.15341	1.72501
6	4	1.10879	.18750	1.81079
7	4	1.41676	.22159	1.02537
8	4	1.63472	.25568	1.44145
9	4	1.85268	.28977	1.54054
10	4	2.07064	.32386	1.50179
11	4	2.28861	.35795	1.50764
12	4	2.50657	.39204	1.34901
13	4	2.72453	.42614	1.27176
14	4	2.94249	.46023	1.18043
15	4	3.16046	.49432	.42841
16	4	3.37842	.52841	.09097
1	5	.10490	.01320	.31117
2	5	.32694	.03977	.55130
3	5	.54891	.06634	.87674
4	5	.76287	.09291	1.01070
5	5	.98083	.11948	1.19413
6	5	1.10879	.14504	1.20822
7	5	1.41676	.17244	1.00347
8	5	1.63472	.19884	1.15004
9	5	1.85268	.22534	.90172
10	5	2.07064	.25184	.94007
11	5	2.28861	.27841	.83045
12	5	2.50657	.30492	.81242
13	5	2.72453	.33141	.69063
14	5	2.94249	.35795	.81010
15	5	3.16046	.38447	.40257
16	5	3.37842	.41098	.29230
1	6	.10490	.00947	.24502
2	6	.32694	.02641	.61404
3	6	.54891	.04335	.85021
4	6	.76287	.06029	.70870
5	6	.98083	.07723	.87014
6	6	1.10879	.09417	.83825
7	6	1.41676	.12311	.73201
8	6	1.63472	.14205	.78140
9	6	1.85268	.16099	.80327
10	6	2.07064	.17992	.84371
11	6	2.28861	.19886	.50245
12	6	2.50657	.21780	.54113
13	6	2.72453	.23674	.45104
14	6	2.94249	.25568	.30820
15	6	3.16046	.27462	.20014
16	6	3.37842	.29356	.13704
1	7	.10490	.00548	.20071
2	7	.32694	.01705	.33504
3	7	.54891	.02862	.52220
4	7	.76287	.04019	.64554
5	7	.98083	.05176	.70810
6	7	1.10879	.06333	.70054
7	7	1.41676	.07489	.64002
8	7	1.63472	.08646	.65104
9	7	1.85268	.09803	.54704

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**TABLE 18.- CONCLUDED.**

10	2	3.02000	.10320	.00100
11	7	2.20061	.11932	.00100
12	7	2.50000	.12000	.00000
13	7	2.72453	.12205	.37103
14	2	3.00000	.10000	.00000
15	7	3.10000	.10077	.21001
16	2	3.30000	.11000	.00000
1	0	.10000	.00100	.19017
2	0	.50000	.00500	.00000
3	0	.50001	.00501	.00000
4	0	.70000	.01000	.00772
5	0	.90003	.01705	.70530
6	0	1.10000	.02000	.00000
7	0	1.01076	.02002	.02501
8	0	1.00000	.02000	.00777
9	0	1.05200	.03220	.50015
10	0	2.00000	.05000	.00000
11	0	2.20061	.03977	.40205
12	0	2.50000	.04000	.44025
13	0	2.72453	.04735	.34070
14	0	3.00000	.05000	.20791
15	0	3.10000	.05492	.20177
16	0	3.30000	.05000	.00000

**FILED**

• SPANLOADS

## "SPANWISE" LOAD DISTRIBUTIONS

~~REFERENCE CHORD 2-3-67~~

COMBINATION		F200		F200		F200		F200		F200	
1	1.09	1.090	1.1	1.090	1.090	1.090	1.090	1.090	1.090	1.090	1.090
2	2.09	2.090	2.1	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
3	3.09	3.090	3.1	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090
4	4.09	4.090	4.1	4.090	4.090	4.090	4.090	4.090	4.090	4.090	4.090
5	5.09	5.090	5.1	5.090	5.090	5.090	5.090	5.090	5.090	5.090	5.090
6	6.09	6.090	6.1	6.090	6.090	6.090	6.090	6.090	6.090	6.090	6.090
7	7.09	7.090	7.1	7.090	7.090	7.090	7.090	7.090	7.090	7.090	7.090
8	8.09	8.090	8.1	8.090	8.090	8.090	8.090	8.090	8.090	8.090	8.090
9	9.09	9.090	9.1	9.090	9.090	9.090	9.090	9.090	9.090	9.090	9.090
10	10.09	10.090	10.1	10.090	10.090	10.090	10.090	10.090	10.090	10.090	10.090
11	11.09	11.090	11.1	11.090	11.090	11.090	11.090	11.090	11.090	11.090	11.090
12	12.09	12.090	12.1	12.090	12.090	12.090	12.090	12.090	12.090	12.090	12.090
13	13.09	13.090	13.1	13.090	13.090	13.090	13.090	13.090	13.090	13.090	13.090
14	14.09	14.090	14.1	14.090	14.090	14.090	14.090	14.090	14.090	14.090	14.090
15	15.09	15.090	15.1	15.090	15.090	15.090	15.090	15.090	15.090	15.090	15.090
16	16.09	16.090	16.1	16.090	16.090	16.090	16.090	16.090	16.090	16.090	16.090
17	17.09	17.090	17.1	17.090	17.090	17.090	17.090	17.090	17.090	17.090	17.090
18	18.09	18.090	18.1	18.090	18.090	18.090	18.090	18.090	18.090	18.090	18.090
19	19.09	19.090	19.1	19.090	19.090	19.090	19.090	19.090	19.090	19.090	19.090
20	20.09	20.090	20.1	20.090	20.090	20.090	20.090	20.090	20.090	20.090	20.090
21	21.09	21.090	21.1	21.090	21.090	21.090	21.090	21.090	21.090	21.090	21.090
22	22.09	22.090	22.1	22.090	22.090	22.090	22.090	22.090	22.090	22.090	22.090
23	23.09	23.090	23.1	23.090	23.090	23.090	23.090	23.090	23.090	23.090	23.090
24	24.09	24.090	24.1	24.090	24.090	24.090	24.090	24.090	24.090	24.090	24.090
25	25.09	25.090	25.1	25.090	25.090	25.090	25.090	25.090	25.090	25.090	25.090
26	26.09	26.090	26.1	26.090	26.090	26.090	26.090	26.090	26.090	26.090	26.090
27	27.09	27.090	27.1	27.090	27.090	27.090	27.090	27.090	27.090	27.090	27.090
28	28.09	28.090	28.1	28.090	28.090	28.090	28.090	28.090	28.090	28.090	28.090
29	29.09	29.090	29.1	29.090	29.090	29.090	29.090	29.090	29.090	29.090	29.090
30	30.09	30.090	30.1	30.090	30.090	30.090	30.090	30.090	30.090	30.090	30.090

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TABLE 19.- SUBROUTINE INPUT FOR APC

```

1      SUBROUTINE INPUT
C
C THIS VERSION OF INPUT IS CONFIGURED TO DETERMINE THE NECESSARY
C GEOMETRY AND SINGULARITY DATA USING A MOTPAN GEOMETRY FILE.
5      C
C DESIGNED BY R. T. HYDAN, APRIL 1977.
C MODIFIED BY W.M.E. DE SILVA, MAY 1978 TO INCORPORATE THE PILOT PANAHN.
C
      LOGICAL GROUP
      LOGICAL LOG
      INTEGER CTIME
      DIMENSION CTIME(5), TITLE(20)
      DIMENSION UVW(40), UVW1(50), UVW2(50), ZI(3,1500)
      DIMENSION GROUP(197), NMUPT(19), NMUPL(19)
15     COMMON /ACASE/ ALPHA(R ), BETA(R ), FSVN(R ), FSV(3,M ),
C
C ACASE, NACASE
      COMMON/ACON/CU1, CU1, TU1(3), TL1(3), DU1, DL1, NET1(8), NCT1, NMUPT1,
      INMUPT1, CU2, CL2, TU2(3), TL2(3), DU2, DL2, NET2(8), NCT2, NMUPT2, NMUPL2
      COMMON/COMPR/ AMACH, HETAMB, RETAM, SBETAM, ARETHS, ALFAYG, HFTAYG,
25     TCOMP(3), ARCTCT(7), ARCTCT(7), CZTNV(3,3)
      COMMON /CONST/ DUHVC(6), NTCF, NTF, DUHYD, NTH
      COMMON /PMCOF/ XREF, YREF, ZREF, SREF, BREF, CREF, DREF, NPMCOF
      COMMON/INDEX/NTS(50), NTD(50), NM(50), NN(50), NA(50), NP(50), NSS(50),
      INS(50), NC(50), NRC(40), NZR(5), HPTST(7), NSSAT(7), NSDRT(7), NCRST(7),
      ZNCA(5), IPOT(50), NNEIT, NZMPT, NPANT, NBNGT, NSNGU, NSNGP, NCTRT, NRCUI
      COMMON /MSPNTS/ ZMCS(1500)
      COMMON /PMNT/ IGDMPP, ISINGP, JCONTP, INCONP, IEDGEPP, ISINGS, IPHACI
      COMMON/CONSP/PI, PT2, PTST
      COMMON /SKRCH1/ TITLE(20), ID(10), LOG(50), INT(52), FLT(40),
30     LOC(61), NRO5(14), A(22234)
      COMMON /SYMM/ NSYMM
      COMMON/DATACR/NOTCHK
      DATA GROUP /, TRUE, .FALSE., .FALSE., .TRUE.,
45     ##, FALSE., ##, TRUE., 5., FALSE./
      DATA MUPT/1, 4, 9, 9, 10, 11, 12, 15, 17, 20,
      #21, 28, 27, 29, 24, 33, 36, 37, 40/
      DATA MUPL/3, 5, 9, 9, 10, 11, 14, 16, 19, 20,
      #23, 26, 27, 28, 32, 37, 38, 39, 40/
      DATA STEK/5, 0/
      DATA MAUPT /7/
      DATA NTG /7/
      NAMELIST/(DATA1)/HNAPE, IONAKE
      NAMELIST /DATA1/ IDG, N1HCL, N1BCL, N2BCL, N2HCL, N1MUPT,
55     I1PUT, N1S, N1D, NTG, STEP
      NAMELIST /DATA2/ ACASE,
      ISINGP, INCONP, IEDGEPP, ISINGS, IPHACI,
      NSYMM, SMPPT, XREF, YREF,
      ZREF, RREF, CREF, DREF, NPMCOF, AMACH, NUTCHN, ALPC, BEIC
      NAMELIST/(DATA3)/ALPHA, BETA, FSVN
      NAMELIST/(DATA4)/NMUPT1, NMUPT2, CU1, CU1, TU1, TL1, DU1, DL1, NCT1, DL1,
      INMUPT2, NMUPT2, CU2, CL2, TU2, TL2, DU2, DL2, NCT2, CL2
C
C THE FOLLOWING IS TEMPORARY FOR DEBUG.
      DO 1 I=1,1500
      ZM(1, I)=11111
      ZM(2, I)=.22201
      ZM(3, I)=.33301
      C INITIALIZE THE SINGULARITY ARRAYS

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ORIGINAL PAGE IS  
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TABLE 19.- CONTINUED.

SUBROUTINE	INPUT	OUTPUT	FOR	DATE	NAME
60	DO 10 I=1,50 NXT(I)=0 10 NTD(I)=0				
65	C C C-----SET LOGICAL UNIT NUMBERS FOR PUTPAN ROUTINES. C-----				
70	C C-----				
75	C C-----DETERMINE NNETIC, NNETIN, THE NUMBER OF COMPONENT & NINE NETWORKS RESPECTIVELY. C-----				
80	C C-----				
85	C C-----DETERMINE NNETT, THE TOTAL NUMBER OF NETWORKS. C-----				
90	C C-----				
95	C C-----				
100	C C-----				
105	C C-----				
110	C C-----				

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OF POOR QUALITY

TABLE 19.- CONTINUED.

SUBROUTINE	INPUT	70/70	OPTS	FIN 0.5000	07/27/70	21,57,510	PAGE	3
115	C	HAPOPT21						
	C	N INCREASES WITH 12						
	C	N INCREASES WITH 11						
	C	HAPOPT23						
	C	N DECREASES WITH 11						
120	C	N INCREASES WITH 17						
	C	HAPOPT24						
	C	N INCREASES WITH 12						
	C	N DECREASES WITH 11						
125	C	THE EXACT EQUATIONS FOR THE CORRESPONDENCE ARE GIVEN IN SUBROUTINE SETPC.						
	C	THE DEFAULT FOR HAPOPT IS 1 FOR THE FIRST NETWORK AND IS THE						
	C	PREVIOUS HAPOPT FOR SUBSEQUENT NETWORKS.						
	C	(IPOT(MNET))-- INDICATOR FOR ALTERNATE POTENTIAL & VELOCITY COMPUTATIONS.						
	C	#02 LOWER SURFACE VALUES TO BE COMPUTED FROM SINGULARITY,						
	C	SPLINES ONLY						
130	C	#01 LOWER SURFACE VALUES TO BE COMPUTED FROM SINGULARITY						
	C	SPLINES & INFLUENCE COEFFICIENTS						
	C	#0 VALUE TO BE COMPUTED FROM INFLUENCE COEFFICIENTS ONLY						
	C	#01 UPPER SURFACE VALUES TO BE COMPUTED FROM SINGULARITY						
	C	SPLINES & INFLUENCE COEFFICIENTS						
135	C	#02 UPPER SURFACE VALUES TO BE COMPUTED FROM SINGULARITY						
	C	SPLINES ONLY						
	C	DEFAULT IS 1.						
	C	(MNET) NETWORK TYPE FOR EACH SOURCE.						
	C	0 SOURCE FREE						
140	C	1 OTHERWISE						
	C	(MNET) DOUBLET TYPE OF NETWORK						
	C	0 DOUBLET FREE						
	C	12 DOUBLETS PRESENT						
145	C	10 DOUBLET MAKE NO.10						
	C	20 DOUBLET MAKE NO.20						
	C	*****THE PROGRAM EXPECTS ANY OF THE FOLLOWING DATA TO BE INPUT						
	C	VIA NAMELIST DATAZ						
	C	NACASE--NUMBER OF FREESTREAM VECTORS FOR WHICH TO OBTAIN SOLUTIONS.						
150	C	DEFAULT IS 1. MAXIMUM ALLOWABLE IS 8.						
	C	ICONT--CONTROLS PRINTOUT OF CONTROL POINT AND BOUNDARY CONDITION						
	C	DIAGNOSTIC DATA. A VALUE OF 1 CAUSES THE PRINTOUT.						
	C	DEFAULT IS 1.						
	C	IGENP--SIMILAR TO ICONT EXCEPT IT CONTROLS GEOMETRY DATA PRINTOUT.						
155	C	DEFAULT IS 1.						
	C	ISING--SIMILAR TO ICONT EXCEPT IT CONTROLS SINGULARITY DATA PRINTOUT.						
	C	DEFAULT IS 1.						
	C	IBCOMP--SIMILAR TO ICONT EXCEPT IT CONTROLS BOUNDARY DATA PRINTOUT.						
	C	IBCOMP--SIMILAR TO ICONT EXCEPT IT CONTROLS EDGE MATCHING DATA PRINTOUT.						
160	C	DEFAULT IS 1.						
	C	ISING--SIMILAR TO ICONT EXCEPT IT CONTROLS SINGULARITY STRENGTH AND						
	C	GRADIENT PRINTOUT. DEFAULT IS 1.						
	C	IPRAIC--INFLUENCE COEFFICIENT DATA PRINTOUT.						
	C	NO IF NO DIAGNOSTIC IS REQUIRED, OTHERWISE FOR P-CONTROL POINT						
165	C	DEFAULT IS 1.						
	C	NSYM--SYMMETRY INDICATOR AS FOLLOWS:						
	C	0 NO SYMMETRY						
	C	1 X-Z IS SYMMETRY PLANE AND PROGRAM EXPECTS Y-Z PLANE						
	C	OF THE CONFIGURATION AS INPUT.						
170	C	DEFAULT IS 0						
	C	2 X-Z AND X-Y ARE PLANES OF SYMMETRY AND PROGRAM EXPECTS						

ORIGINAL PAGE IS  
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TABLE 19.- CONTINUED.

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SUBROUTINE INPUT      707th Opns      114 1.50000      21.57.710      PAGE 4

C      Y,GE,0 AND Z,GE,0 QUANTER OF THE CONFIGURATION AS INPUT.
C SREP--REFERENCE AREA FOR ENTIRE CONFIGURATION, DEFAULT IS PLT(1) FROM THE
C LAST POTPAN GEOMETRY FILE READ IN.
175 C XREP,YREP,ZREP--LOCATION ABOUT WHICH MOMENTS WILL BE COMPUTED.
C DEFAULTS ARE FLT(10),FLT(11), AND FLT(12) FROM THE LAST POTPAN
C GEOMETRY FILE READ IN.
C SREP,CREP,UREP--REFERENCE LENGTHS FOR NONDIMENSIONALIZING MOMENTS ABOUT THE
C X, Y, AND Z AXES, RESPECTIVELY, DEFAULTS ARE PLT(2), PLT(3), AND PLT(4)
180 C FROM THE LAST POTPAN GEOMETRY FILE READ IN.
C AMACH--FREE STREAM MACH NUMBER, DEFAULT IS ZERO.
C NOTCHK--DATA CHECK FLAG, (IF=1 DATA CHECK ONLY, OTHERWISE FULL SOLUTION)
C LEFTCOMPRESSIBILITY DIRECTION ANGLE OF ATTACK IN DEGREES.
185 C DEFAULTING.
C BEYCOMPRESSIBILITY DIRECTION ANGLE UP YAW IN DEGREES.
C DEFAULTING.
C-----
C-----THE PROGRAM EXPECTS ANY OF THE FOLLOWING DATA TO BE
190 C INPUT VIA NAMELIST DATAS
C (ALPHA(NACASE))--ANGLE OF ATTACK FOR EACH CASE, DEFAULT IS 0.0.
C (RETA(NACASE))--ANGLES OF STOELEP FOR EACH CASE, POSITIVE VALUES IMPLY
C PRESTREAM CURVING FROM THE RIGHT, DEFAULT IS 400.0
C (PSV(NACASE))--MAGNITUDES OF THE PRESTREAM SPEED FOR EACH CASE,
C DEFAULT IS 0.1.0.
195 C-----READ IN REMINDER OF REQUIRED INPUT DATA
C-----
C-----THE PROGRAM EXPECTS ANY OF THE FOLLOWING DATA TO BE INPUT
C VIA NAMELIST DATAS
200 C CU,CL,DI,DL,DU,DI--SAME AS IN EN.2 NASA CR-152047, PAGE 18.
C 182 REFERS TO THE FIRST & SECOND BOUNDARY CONDITIONS.
C DEFAULT VALUES 0.0
C (MET1(NACASE))--FIRST BOUNDARY CONDITION (MULTIPLE) M.M.S. VALUES
C --DEFAULT IS 0.
205 C (MET2(NACASE))--SECOND BOUNDARY CONDITION (MULTIPLE) M.M.S. VALUES
C --DEFAULT IS 0.
C NLOPT1,NLOPT2--PARAMETERS GOVERNING LEFT SIDES FOR THE TWO
C BOUNDARY CONDITIONS AT THE CONTROL POINTS (IF ONLY ONE BOUNDARY
C CONDITION IS APPLIED, ONE OF THESE PARAMETERS IS SET TO ZERO)
210 C --DEFAULT IS 1.
C NROPT1,NROPT2--PARAMETERS GOVERNING CORRESPONDING M.M.S. OF THE
C TWO BOUNDARY CONDITIONS
C --DEFAULT IS 1.
215 COMMENT NLOPT2,3,4,5 FOR NORMAL MASS FLOW M.C.
C 11,12,13,14 FOR NORMAL VELOCITY M.C.
COMMENT NROPT3 (IMPERMEABILITY) FOR THE ABOVE VALUES OF NLOPT
C-----
220 READ(5,DATA2)
WRITE(6,DATA2)
DO 1000 I=1,NACASE
READ(5,DATA3)
WRITE(6,DATA3)
1000 CONTINUE
225 READ(5,DATA3)
WRITE(6,DATA3)
ALFAV=0.0
RETA=0.0
IF (AMACH,LE,0.0) GO TO 30
C-----CALCULATE AVERAGE ALPHA AND RETA
DO 25 I=1,NACASE

```

**TABLE 19.- CONTINUED.**

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TABLE 19.- CONTINUED.

SUBROUTINE INPUT	FORMAT	OPTION	DATA	PAGE
			<pre> IF(NIBCL.EQ.0) NIBCL=1 IF(NIBCU.EQ.0) NIBCU=1 IF(NIBCL.EQ.0) NIBCL=1 IF(NIBCU.EQ.0) NIBCU=1 </pre>	
290			<pre> C===== C-----CORNER POINTS INTO ARRAY ZH. C-----ZM(1,L)=1TH COORDINATE OF THE LTH GRID POINT(1,1/2,3) FROM PUTHM. C----- C-----NMAX=NO. OF PANELS IN THE APC 1 OR 4 DIRECTION FOR THE CURRENT NEIGHA. C-----NMAX=NO. OF PANELS IN THE APC 3 OR 4 DIRECTION FOR THE CURRENT NEIGHA. </pre>	
295			<pre> IF(NAPOT.EQ.1 .OR. NAPOT.EQ.3) NMAX=NIBCU+NIBCL*2 IF(NAPOT.EQ.1 .OR. NAPOT.EQ.3) NMAX=NIBCU+NIBCL*2 IF(NAPOT.EQ.2 .OR. NAPOT.EQ.4) NMAX=NIBCU+NIBCL*2 IF(NAPOT.EQ.2 .OR. NAPOT.EQ.4) NMAX=NIBCU+NIBCL*2 </pre>	
300			<pre> LOCXPLC(1) LOCXPLC(2) LOCXPLC(3) </pre>	
305			<pre> CALL SETXINT, NIBCL, NIBCU, N2, NIBCL, NIBCU, NMAX, NMAX, NAPOT, ZM(1,L+1), A(LOCXPLC), A(LOCXPLC), A(LOCXPLC) C-----INCREMENT TOTAL CORNER POINT COUNTER, L=L+NMAX+NMAX C-----STORE NUMBER OF CORNER POINTS. C-----NM(K),NM(K)=THE NUMBER OF ROWS &amp; COLUMNS RESPECTIVELY IN THE K-NEIGHA </pre>	
310			<pre> NM(1)=NMAX NM(2)=NMAX </pre>	
315			<pre> C-----SET UP BOUNDARY CONDITION SPECIFICATIONS C----- NMAX=NMAX+1 DO 250 N=1,NMAX DO 250 N=1,NMAX IPN=IPN+1 CALL TTRN(TPN,CUT) </pre>	
320	260		<pre> CONTINUE 250 CONTINUE </pre>	
325			<pre> C===== C-----PRINT SUMMARY INFORMATION FOR NETWORK(COMPONENT) C===== WRITE(6,900)NIBCL IF(NIBCL.NE.1)WRITE(6,9007)NIBCL IF(NIBCU.NE.1)WRITE(6,9008)NIBCU WRITE(6,9009)NIBCL IF(NIBCU.NE.1)WRITE(6,9010)NIBCU IF(NIBCL.NE.1)WRITE(6,9011)NIBCL IF(NIBCU.NE.1)WRITE(6,9012)NIBCU </pre>	
330			<pre> C===== C===== C-----DETERMINE REMAINDER OF REQUIRED DATA C===== NREF=FLT(1) NREF=FLT(2) NREF=FLT(3) NREF=FLT(4) NREF=FLT(10) NREF=FLT(11) NREF=FLT(12) </pre>	

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**TABLE 19.- CONTINUED.**[illegible]

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TABLE 19.- CONCLUDED.

SUBROUTINE	INPUT	76/76	OPT=1	FIN 4.5000	07-27-70	21-57-510	PAGE	4
	6002	FORMAT(/22H0COMPONENT NETWORK NO., 13/ 22H -----)						
	6003	FORMAT(6H0DATES, A10)						
000	6004	FORMAT(20H NO. OF 11 PANELS #, 15)						
	6007	FORMAT(20H LOWEST 11 PANEL #, 15)						
	6008	FORMAT(20H HIGHEST 11 PANEL #, 15)						
	6009	FORMAT(20H NO. OF 12 PANELS #, 15)						
405	6010	FORMAT(20H LOWEST 12 PANEL #, 15)						
	6011	FORMAT(20H HIGHEST 12 PANEL #, 15)						
	6012	FORMAT(20H MAPPING OPTION #, 15)						
	6013	FORMAT(23H LOWER SURFACE SCONS #, F10.4)						
090	6014	FORMAT(23H UPPER SURFACE SCONS #, F10.4)						
	6015	FORMAT(27H UPPER SURFACE SCON VECTOR# F10.4)						
	6016	FORMAT(27H LOWER SURFACE SCON VECTOR# F10.4)						
	6021	FORMAT(20H0TOTAL NO. CORNER POINTS #, 15/ 20H0TOTAL NO. PANELS #, 15)						
	6022	FORMAT(10H SYMMETRY # NONE)						
475	6023	FORMAT(21H SYMMETRY # X=Z PLANE)						
	6024	FORMAT(7H SREF# F15.7)						
	6025	FORMAT(7H SREF# F15.7, 10X, 6HREF #, F15.7, 10X, 6HREF #, F15.7)						
	6026	FORMAT(7H XREF #, F15.7, 10X, 6HREF #, F15.7, 10X, 6HREF #, F15.7)						
000	6027	FORMAT(7H HACH #, F15.7, 8X, 6HALFVG #, F15.7, 8X, 6HBETAVG #, F15.7)						
	6028	FORMAT(23H FLOW IS INCOMPRESSIBLE)						
	6029	FORMAT(5H0CASE, 11X, 5H0ALPHA, 10X, 4H0ETA, 11X, 5H0ABS(VINF) )						
405	6030	FORMAT(14, 8X, 3F15.7)						
	6031	FORMAT(/10X, 11HSINGULARITY, 9X, 11HSINGULARITY, 11X, 7HSUNFACE/ 8H NETWORK# 12X, 4HTYPE (INT), 10X, 11HORDER (INSO), 9X, 11HORDER (NO) )						
400	6032	FORMAT(15, 3I20)						
	6033	FORMAT(1H1/1H0/11H0COMPONENTS/11H -----)						
	6034	FORMAT(20H NO. OF CORNER POINTS DESCRIBING EACH SHED VORTEX LINE # 1, 15)						
	6035	FORMAT(27H NO. OF SHED VORTEX LINES #, 15)						
405	7002	FORMAT(/17H0WAKE NETWORK NO., 13/ 20H -----)						
	7033	FORMAT(1H1/1H0/6H0WAKES/6H -----)						
	8000	FORMAT(20H WAKE FILE CREATION TIME #, 31X) END						

**TABLE 20.- TRAILING EDGE PLANAR WAKE SHEET.**

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TABLE 21.- DATA FOR SUBROUTINE INPUT

ADVANCED PANEL PILOT CODE WITH PATCHES INPUT  
\*\*\*\*\*

NUMBER OF NETWORKS IN CONFIGURATION = 2

NUMBER OF WARE NETWORKS = 1

DATE = 07/27/74  
TIME = 22.02.52

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TABLE 21.- CONTINUED.

DATA?  
NACASF = 1,  
YCONTP = 0,  
YGEUMP = 0,  
YBINGM = 0,  
YHCONP = 0,  
YEDGTP = 0,  
YSINGS = 0,  
YPRATC = 0,  
NSYMM = 1,  
SHEF = .1E+01,  
XHEF = 0.0,  
YHEF = 0.0,  
ZHEF = 0.0,  
RHEF = .1E+01,  
CHEF = .1E+01,  
DHEF = .1E+01,  
NPRCIF = 4,  
AMACH = 0.0,  
NDTCHM = 1,  
ALPL = 0.0,  
BPTC = 0.0,  
END

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TABLE 21.- CONTINUED.

SDATA3

ALPHA = .2E+02, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,

BETA = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,

PSYCH = .1E+01, .1E+01, .1E+01, .1E+01, .1E+01, .1E+01, .1E+01, .1E+01,

SEND

FLOW IS INCOMPRESSIBLE

CASE	ALPHA	BETA	PSYCH (INF)
1	20.0000000	0.0000000	1.0000000

**TABLE 21.- CONTINUED.**

8FND

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TABLE 21.- CONTINUED.

QDATA

NLOPT1 = 0,

NROPT1 = 0,

CUI = 0.0,

CL1 = 0.0,

TU1 = 0.0, 0.0, 0.0,

TL1 = 0.0, 0.0, 0.0,

DU1 = 0.0,

DL1 = 0.0,

NCT1 = 2,

RET1 = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,

NLOPT2 = 2,

NROPT2 = 3,

TU2 = 0.0,

CL2 = 0.0,

TUR = 0.0, 0.0, 0.0,

TL2 = 0.0, 0.0, 0.0,

DU2 = 0.0,

DL2 = 0.0,

NCT2 = 2,

RET2 = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,

QEND

COMPONENT NETWORK NO. 1

FILE PF30701GHI ATTACHED AS TAP15

ENTER RDGMA. IUA= 30701

TITLE= WING GEOMETRY FILE FOR USE WITH THE APC

CTIME = 07/27/78 21.50.56

INIT 15 REWOUND AND RETURNED

EXIT RDGMA. DATA STORED IN LOCS 1 THROUGH 3009-1

INIT 15 REWOUND AND RETURNED

NO. OF 11 PANELS = 19

NO. OF 12 PANELS = 15

WAPPING OPTION = 1

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TABLE 21.- CONTINUED.

COMPONENTS  
-----

TOTAL NO. CURVED POINTS = 256

TOTAL NO. PANELS = 225

SYMMETRY = X-Z PLANE

SREF = 1.7437000

QREF = 1.0000000

YREF = 0.0000000

LREF = 3.4470000  
TREF = 0.0000000

DREF = 1.0000000  
ZREF = 0.0000000

4

**TABLE 21.- CONTINUED.**

76

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TABLE 21.- CONTINUED.

```

SDATAH
NLOPT1 = 0,
NROPT1 = 0,
CUI    = 0.0,
CL1    = 0.0,
TUI    = 0.0, 0.0, 0.0,
TL1    = 0.0, 0.0, 0.0,
DU1    = 0.0,
DL1    = 0.0,
NCT1   = 2,
NET1   = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
NLOPT2 = 2,
NROPT2 = 3,
CU2    = 0.0,
CL2    = 0.0,
TU2    = 0.0, 0.0, 0.0,
TL2    = 0.0, 0.0, 0.0,
DU2    = 0.0,
DL2    = 0.0,
NCT2   = 2,
NET2   = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
SEND

```

COMPONENT NETWORK NO. 2

FILE PF53176GM1 ATTACHED AS TAPES

ENTER NOGMA, IMA, SAITA

TITLE = RECTANGULAR PLANE GEOMETRY FILE

```

CTIME = 07/27/78 21.57.01
UNIT 15 REQUESTED AND RETURNED
EXIT NOGMA, DATA STORED IN LIPS 1 THROUGH 277-1
UNIT 15 REQUESTED AND RETURNED
NO. OF 11 PANELS = 15
NO. OF 12 PANELS = 1
MAPPING OPTION = 1

```

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TABLE 21.- CONTINUED.

COMPONENTS  
-----

TOTAL NO. CORNER POINTS = 288

TOTAL NO. PANELS = 240

SYMMETRY = X-Z PLANE

AMEP = 1.7437000

AMEP = 1.0000000

AMEP = 0.0000000

AMEP = 3.4874000  
AMEP = 0.0000000

AMEP = 1.0000000  
AMEP = 0.0000000

NETWORK	SINGULARITY TYPE (MT)	SINGULARITY ORDER (NBO)	SINGULARITY ORDER (NBO)
1	0	12	
2	0	18	

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TABLE 21.- CONTINUED.

SDATAN

NYNAME = 10.

YDNAME = 10701,

SEND

FILE PF30701461 ATTACHED AS TAPE10  
NAME FILE CREATION TIME 807/27/78  
INIT 10 REBOUND AND RETURNED

21.57.00

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**TABLE 21.- CONTINUED.**

DATA:

106- 53170.

WIDCL - 9,

NICU - 0,

WEST - 44-38861

N2HCU 0,

НАРОДЪТ • 4,

1907. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 8

[illegible]

NFD    ■ 12, 18, 9, 0, 9, 0, 6, U, 9, 7, 0, 7, 0, 0, 0, U, U, n, U, u, 0, ...

0, 0, 0, 0, 0, n, n, n, n, n, n, u, u, u, n,

NTG      • 15.

STEP = .75E+02,

SEND

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TABLE 21.- CONTINUED.

```

$DATA
NLOPT1 = 0,
NMOPT1 = 0,
CUI    = 0.0,
CLI    = 0.0,
TUI    = 0.0, 0.0, 0.0,
TLI    = 0.0, 0.0, 0.0,
DUI    = 0.0,
DLI    = 0.0,
NCT1   = 2,
RETI   = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
NLOPT2 = 2,
NMOPT2 = 3,
CU2    = 0.0,
CL2    = 0.0,
TU2    = 0.0, 0.0, 0.0,
TL2    = 0.0, 0.0, 0.0,
DU2    = 0.0,
DL2    = 0.0,
NCT2   = 2,
REI2   = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
$END

```

NAME AFTERNAME NO. 1

-----  
 NO. OF SHED VORTEX LINES = 10  
 NO. OF CORNER POINTS DESCRIBING EACH SHED VORTEX LINE = 51

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TABLE 21.- CONCLUDED.

WAKES  
-----

TOTAL NO. CORNER POINTS = 1104

TOTAL NO. PANELS = 400

SYMMETRY = X-Z PLANE

NETWORK	SINGULARITY TYPE (NT)	SINGULARITY ORDER (NS)	SURFACE ORDER (NP)
3	0	14	

INIT COST	ELAPSED CPU TIME	.210
-----------	------------------	------

INIT COST	ELAPSED CPU TIME	.001
-----------	------------------	------

**TABLE 22.- DAY FILE FOR VORTEX ROLLUP PROGRAM WITH APC**

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TABLE 22.- CONTINUED.

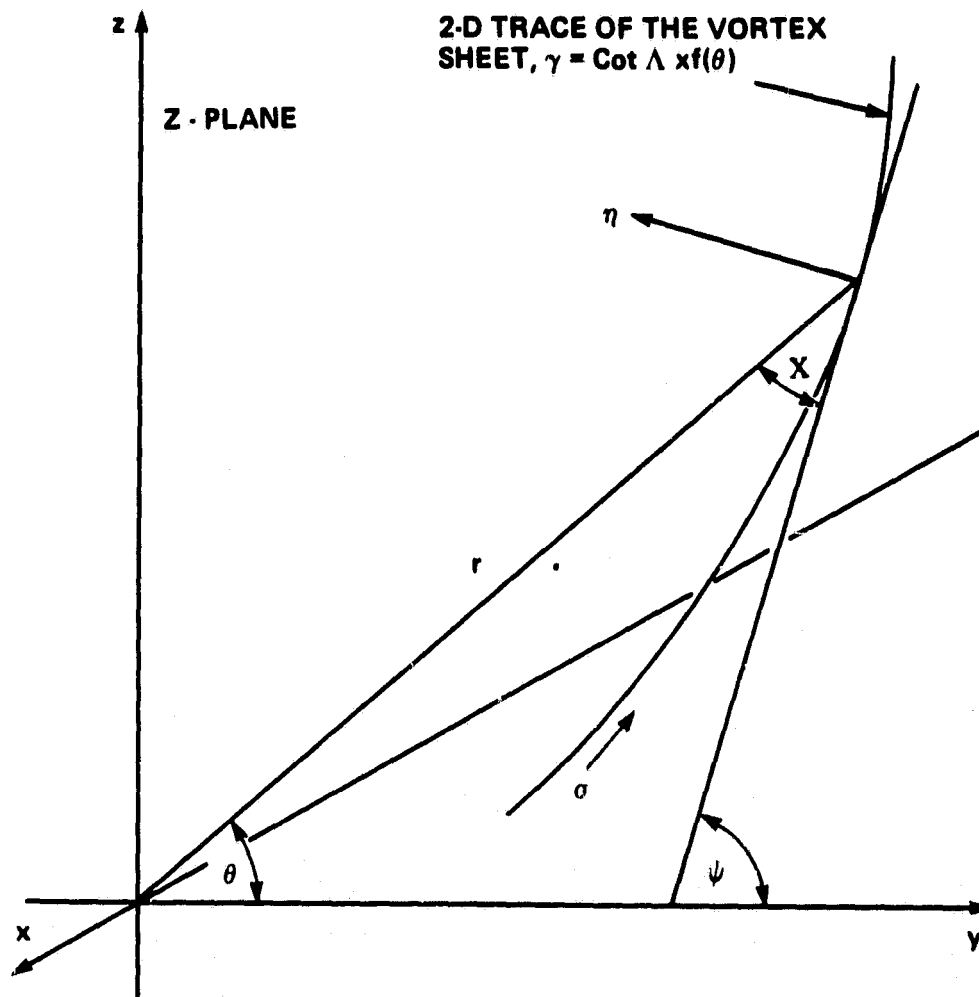
21.57.49 00049.240 ARC.	RP727 - VSN 00177H OF SET CAPAIRI MOUNTED
21.57.49 00049.255 ARC.	JN234 - VACUOUS FILE SPECIFIED - PUNGENE
21.57.49 00049.255 ARC.	PF040 - PF040C - CATALOGED ON TAPE3 - PF07010H
21.57.49 00049.261 ARC.	PF060 - CYCLE 1 CATALOGED ON SMCAPAIRI
21.57.50 00049.273 USR.	STOP
21.57.50 00049.273 USR.	42.002 CP SECONDS EXECUTION TIME
21.57.50 00049.273 LOD.	-REWIND,TAPE2.
21.57.50 00049.280 JON.	-DISPOSE,TAPE2,SYNABIRM,PF040.
21.57.50 00049.291 LOD.	/*N,OPTIM,NO3,SUPPLYTEXT,SUBSYSTEM.
21.57.54 00049.907 USR.	402 CP SECONDS COMPILATION TIME
21.57.54 00049.907 LOD.	-REWIND,LGO.
21.57.55 00050.002 JON.	-SETNAME(FASRRPG)
21.57.55 00050.002 JON.	-MOUNT(VSN00177H)
21.57.55 00050.002 JON.	RP570 - VSN 00110A OF SET FASRRPG MOUNTED
21.57.55 00050.023 ARC.	-ATTACH,LIB,SYNABIRM,TOPPER
21.57.55 00050.028 JON.	PF254 - CYCLE 5 ATTACHED FROM SMCAPAIRI
21.57.55 00050.032 ARC.	-ATTACH,LIB,SYNABIRM,TOPPER.
21.57.55 00050.032 JON.	PF254 - CYCLE 5 ATTACHED FROM SMCAPAIRI
21.57.55 00050.036 ARC.	-ATTACH,LIB,TECHN,TOPPER.
21.57.55 00050.037 JON.	PF254 - CYCLE 1 ATTACHED FROM SMCAPAIRI
21.57.55 00050.041 ARC.	-ATTACH,LIB,SYNABIRM,TOPPER.
21.57.55 00050.042 JON.	PF254 - CYCLE 5 ATTACHED FROM SMCAPAIRI
21.57.55 00050.046 ARC.	-LIBROT,UPDATE LIB WITH LGO,CREATING LIB.
21.57.55 00050.047 LOD.	FORTHAN LIBRARY 414 US/12/76
21.57.55 00050.071 USR.	RP727 - VSN 00110A OF SET FASRRPG MOUNTED
21.57.55 00050.101 ARC.	STOP
21.57.55 00050.817 USR.	1749 CP SECONDS EXECUTION TIME
21.57.55 00050.817 USR.	-REWIND,LGO.
21.57.55 00050.831 LOD.	-FTN,COMPILE MAIN PROGRAM
21.57.55 00050.957 USR.	112 CP SECONDS COMPILATION TIME
21.57.55 00050.958 LOD.	-REWIND,LGO.
21.57.55 00050.972 JON.	-SETNAME(CAPAIRI)
21.57.55 00050.972 JON.	-MOUNT(VSN00177H)
21.57.55 00050.978 ARC.	RP1034 - VSN 00177H OF SET CAPAIRI MOUNTED
21.57.55 00050.978 LOD.	-COPYL,A,LGO,M.
21.57.55 00051.004 ARC.	RP727 - VSN 00110A OF SET FASRRPG MOUNTED
21.57.55 00051.007 USR.	UT046 - UPDATED PARTITION - FEE
21.57.55 00051.022 USR.	UT055 - COPYL COMPLETE
21.57.55 00051.022 LOD.	-REWIND,R.
21.57.55 00051.037 JON.	-LIBRARY,LIB,LIB2,LIB3,E.
21.57.55 00051.037 LOD.	-RETURN,TAPE1.
21.57.55 00051.047 ARC.	RP727 - VSN 00110A OF SET FASRRPG MOUNTED
21.57.55 00051.056 ARC.	RP727 - VSN 00110A OF SET FASRRPG MOUNTED
21.57.55 00051.073 LOD.	-RETURN,TAPE2.
21.57.55 00051.095 ARC.	JN234 - VACUOUS FILE SPECIFIED - TAPE2
21.57.55 00051.095 LOD.	-RETURN,TAPE1.
21.57.55 00051.116 LOD.	-RETURN,TAPE2.
21.57.55 00051.138 LOD.	-R.
21.57.55 00053.027 ARC.	LD005 - ABSOLUTE FILE WRITTEN OS.COB
21.57.55 00053.027 ARC.	LD010 - FLS REQUIRED TO LOAD - OUTR12 US,OVGA
21.57.55 00053.051 USR.	FORTHAN LIBRARY 414 09/12/76
21.57.55 00053.080 ARC.	JN234 - VACUOUS FILE SPECIFIED - TAPE15
21.57.55 00053.082 ARC.	PF040 - PF040C - ATTACH - TAPE15 - PF07010H
21.57.55 00053.089 ARC.	PF254 - CYCLE 1 ATTACHED FROM SMCAPAIRI
21.57.55 00053.093 ARC.	RP727 - VSN 00177H OF SET CAPAIRI MOUNTED
21.57.55 00053.137 ARC.	PF040 - PF040C - ATTACH - TAPE15 - PF07010H
21.57.55 00053.144 ARC.	PF254 - CYCLE 1 ATTACHED FROM SMCAPAIRI
21.57.55 00053.144 ARC.	RP727 - VSN 00177H OF SET CAPAIRI MOUNTED
21.57.55 00053.164 ARC.	JN234 - VACUOUS FILE SPECIFIED - TAPE16
21.57.55 00053.171 ARC.	PF040 - PF040C - ATTACH - TAPE16 - PF07010H

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TABLE 22.- CONCLUDED.

23.02.54 00053.170 ARC.	PF254 - CYCLE 1 ATTACHED FROM SHOCAPAINI	
22.02.54 00053.182 ARC.	HP727 - VSN 00177R OF SEY CAPAINI MOUNTED	
23.03.27 00002.700 USR.	STOP	
23.03.27 00002.700 USR.	344.411 CP SECONDS EXECUTION TIME	
23.03.27 00002.702 ARC.	HM770 - MAXIMUM ACTIVE FILES	149
23.03.27 00002.702 ARC.	HM771 - OPEN/CLOSE CALLS	42,000
23.03.27 00002.702 ARC.	HM772 - DATA TRANSFER CALLS	250
23.03.27 00002.702 ARC.	HM773 - CONTROL/POSITIONING CALLS	19,920
23.03.27 00002.702 ARC.	HM774 - SW DATA TRANSFER CALLS	571
23.03.27 00002.703 ARC.	HM775 - HW CONTROL/POSITIONING CALLS	20,901
23.03.27 00002.703 ARC.	HM776 - QUEUE MANAGER CALLS	20,500
23.03.27 00002.703 ARC.	HM777 - RECALL CALLS	
23.03.27 00002.703 ARC.	SCM 19 164,764 K-S	
23.03.27 00002.703 ARC.	LCH 22,470 K-S	
23.03.27 00002.704 ARC.	ITG 22,285 K-S	
23.03.27 00002.704 ARC.	KMS 726,175 K-S	
23.03.27 00002.704 ARC.	USER 374,892 SEC	
23.03.27 00002.704 ARC.	JPH 402,706 SEC	
23.03.27 00002.704 ARC.	DIO 49 915,167 K-S	
23.03.27 00002.704 ARC.	MAXIMUM154K MAX10111K MAXIMUM334K	
23.03.27 00002.704 ARC.	6.9K DENSITY K ACCOUNTING UNITS B	193.70
23.03.27 00002.705 ARC.	SCU40 - 080637 SC/LC SW475	

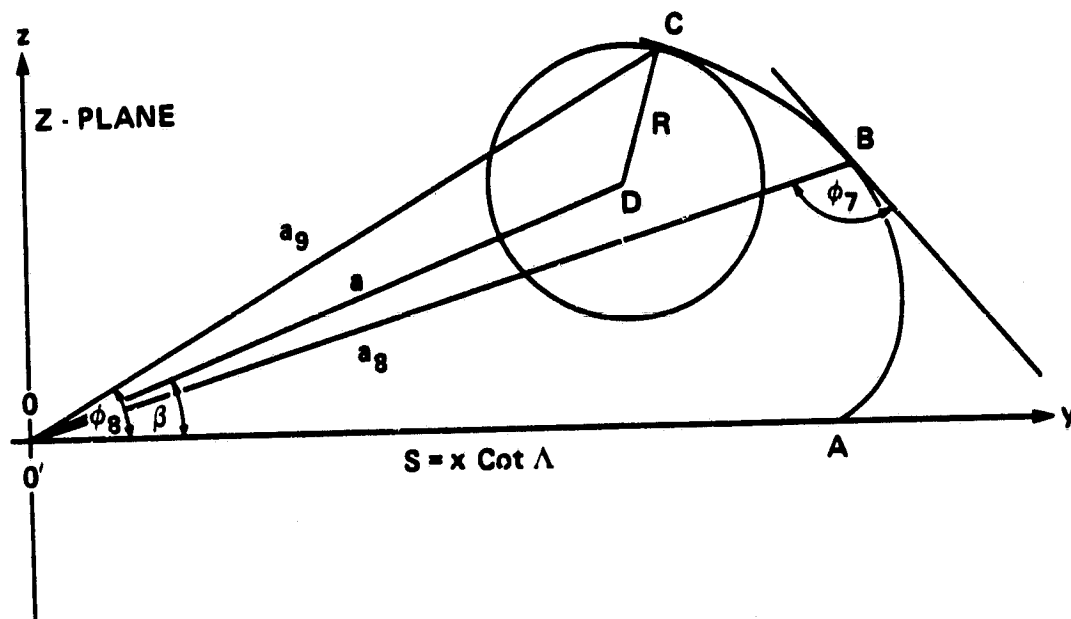
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(a) Coordinates for cross section  
(ref. 1).

Figure 1.- Mangler-Smith Vortex Rollup Analysis.

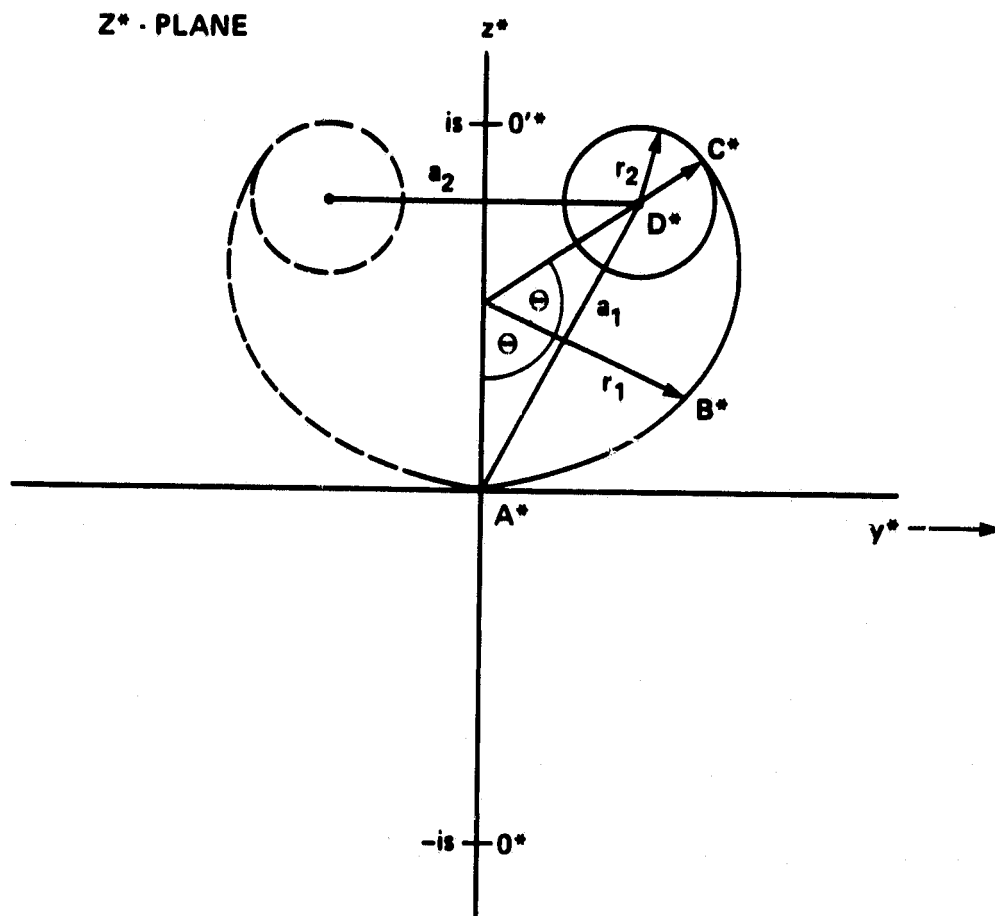
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(b) Approximation sheet  
(ref. 1).

Figure 1.- Continued.

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(c) Transform of figure 1(b).

Figure 1.- Concluded.

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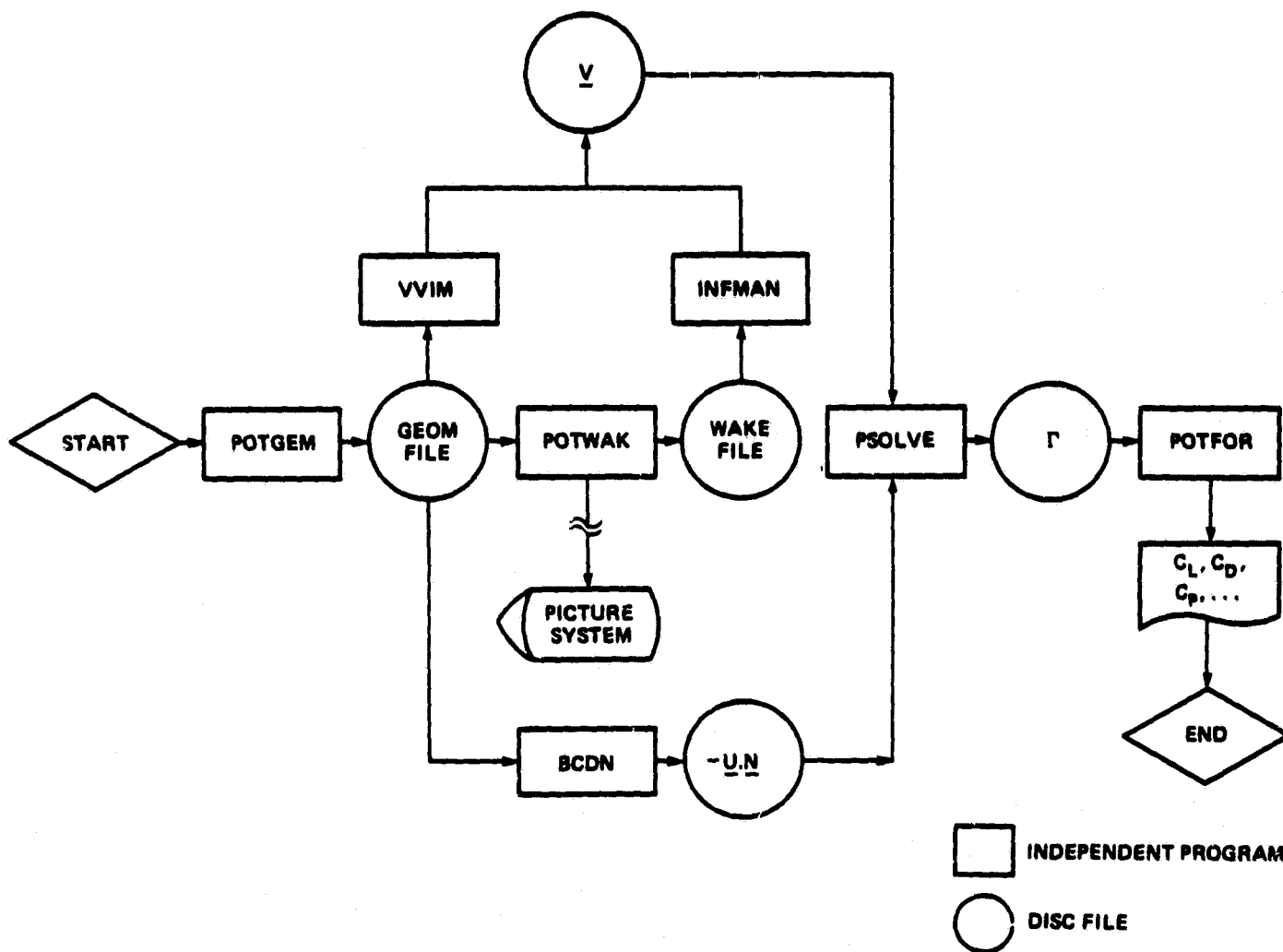
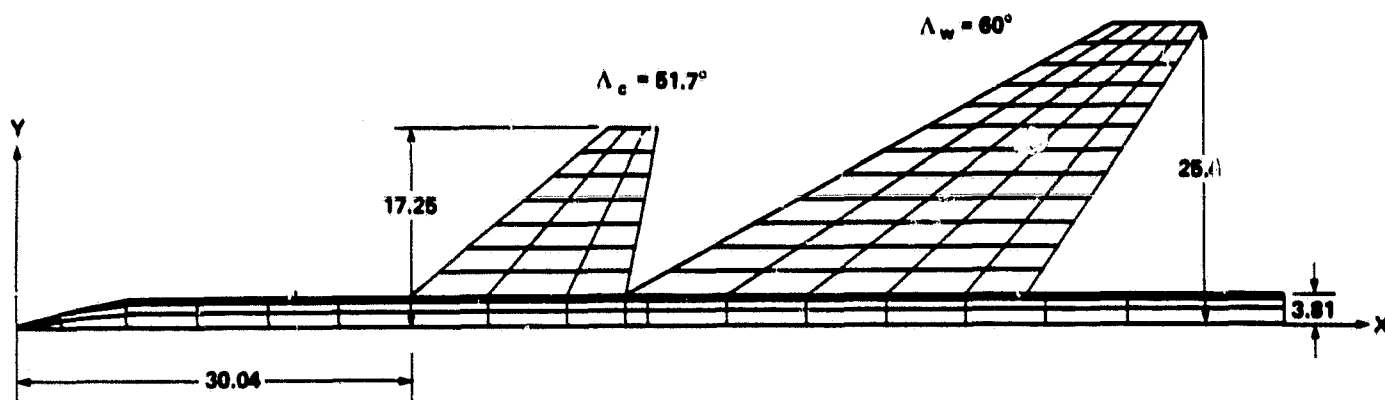


Figure 2.- POTFAN system.

The diagram illustrates the flow field around a wing section. The horizontal axis is labeled  $y$  (STARBOARD),  $V$  and the vertical axis is labeled  $x, S$ . The origin is marked  $(0, 0)$ . The wing section is represented by a curved line labeled  $SL(v)$ . The leading edge is labeled  $L.E. ROLL UP$ . The trailing edge is labeled  $T.E.$ . The flow field is divided into regions by shock waves and streamlines. The regions are labeled with circled numbers: 2, 4, 9, 17. The shock waves are labeled  $VU(s)$  and  $VL(s)$ . The wake lines are labeled  $SU(v)$ . The free stream direction is indicated by an arrow pointing downwards. The straight T.E. wake lines are indicated by arrows pointing upwards.

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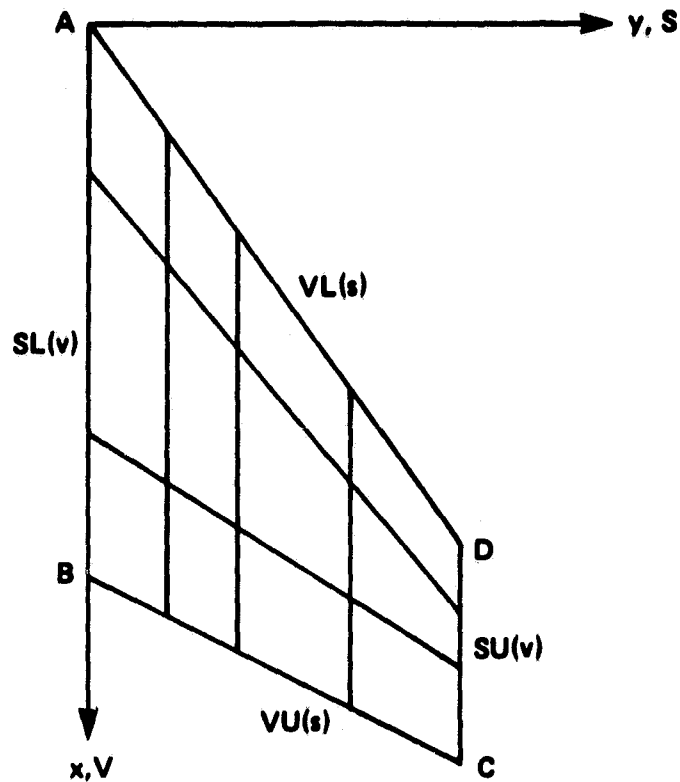
DIMESNIONS IN cm

	CANARD	WING
L.E. SWEEP ANGLE	51.7°	60°
ROOT CHORD	17.61	29.8
TIP CHORD	3.59	6.77
AREA	288.73	1032.2

DISTANCE OF AERODYNAMIC CENTER  
FROM NOSE = 59.14

Figure 4.- Close-coupled canard wing-model of reference 8.

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COORDS (x, y)	CANARD II	WING I
A	(30.04, 3.81)	(47.65, 3.81)
B	(47.65, 3.81)	(77.45, 3.81)
C	(50.65, 17.25)	(91.81, 25.40)
D	(47.06, 17.25)	(85.04, 25.40)

Figure 5.- Planform boundary curves in POTGEM.

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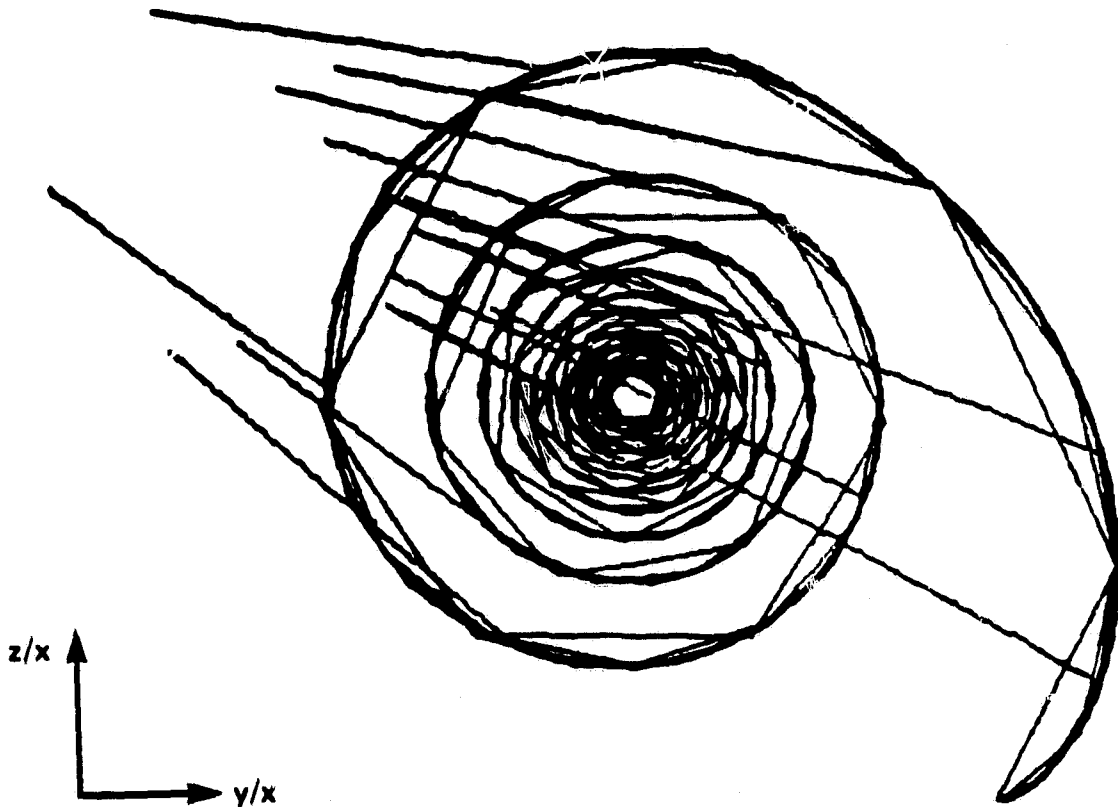
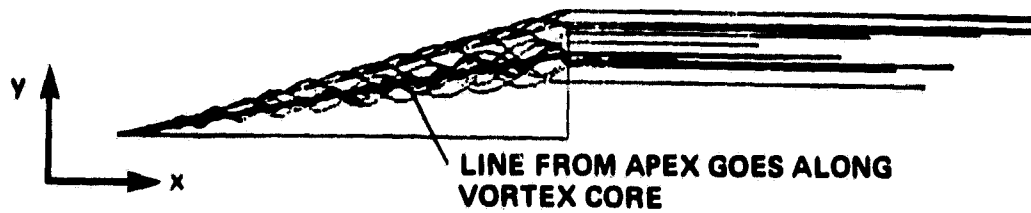


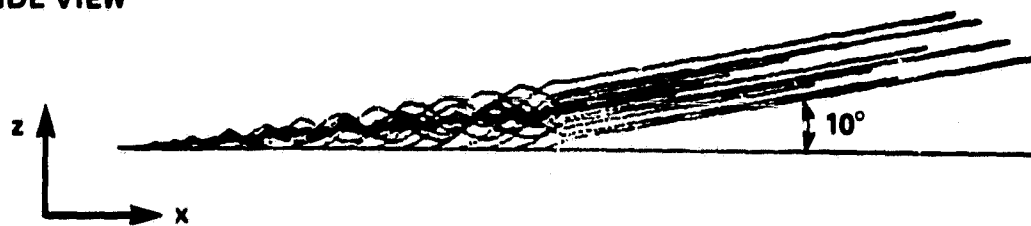
Figure 6.- Vortex rollup for delta wing at 20° angle of attack.

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TOP VIEW



SIDE VIEW



FRONT VIEW

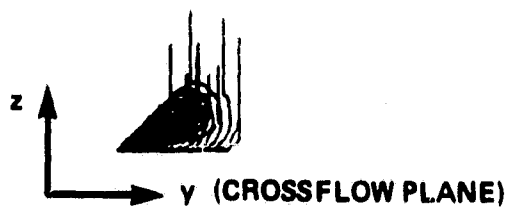


Figure 7.- Different views of trajectories.

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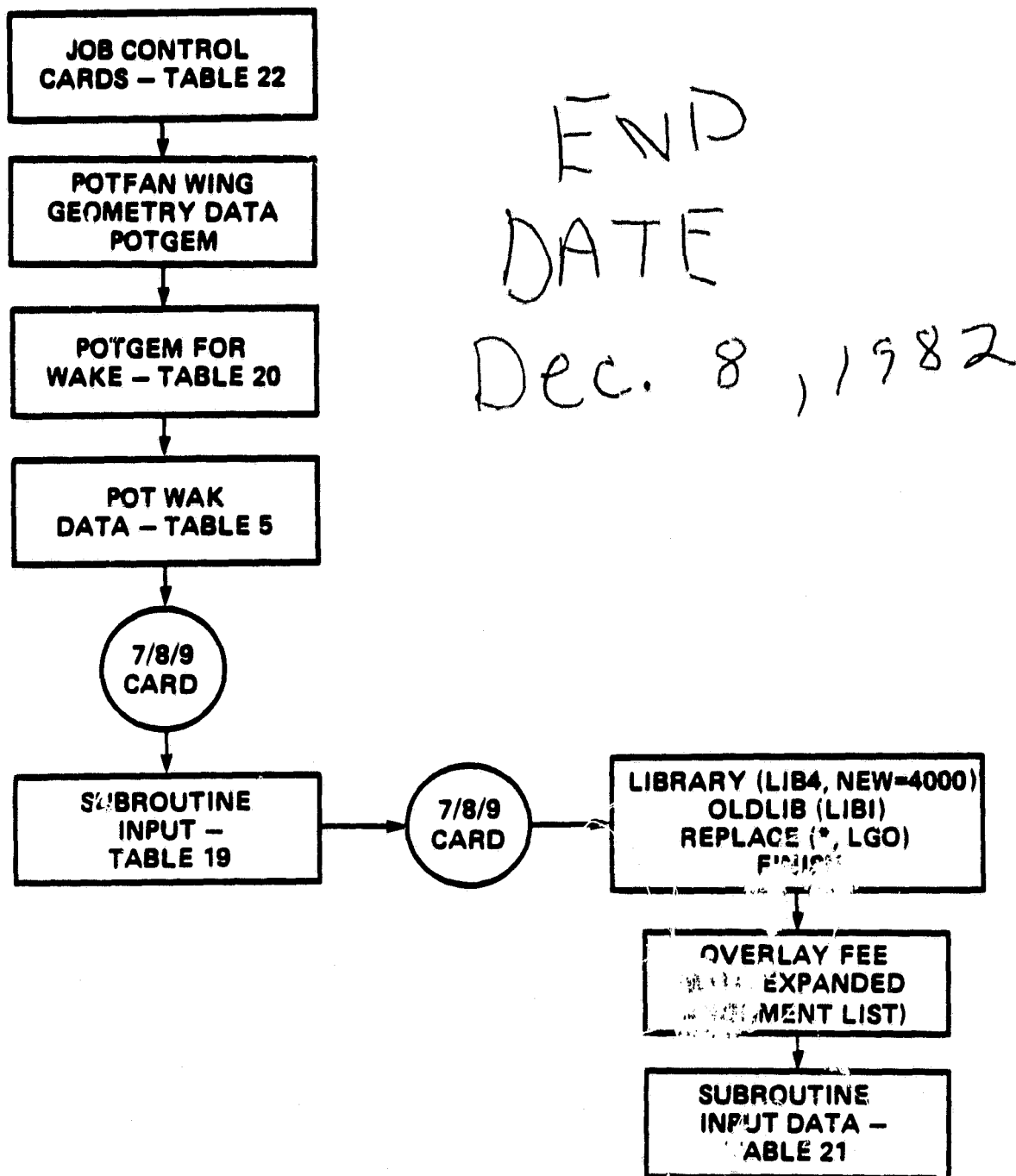


Figure 8.- Program structure for APC with POTGEM, POTWAK.